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APRIL 27, 1961

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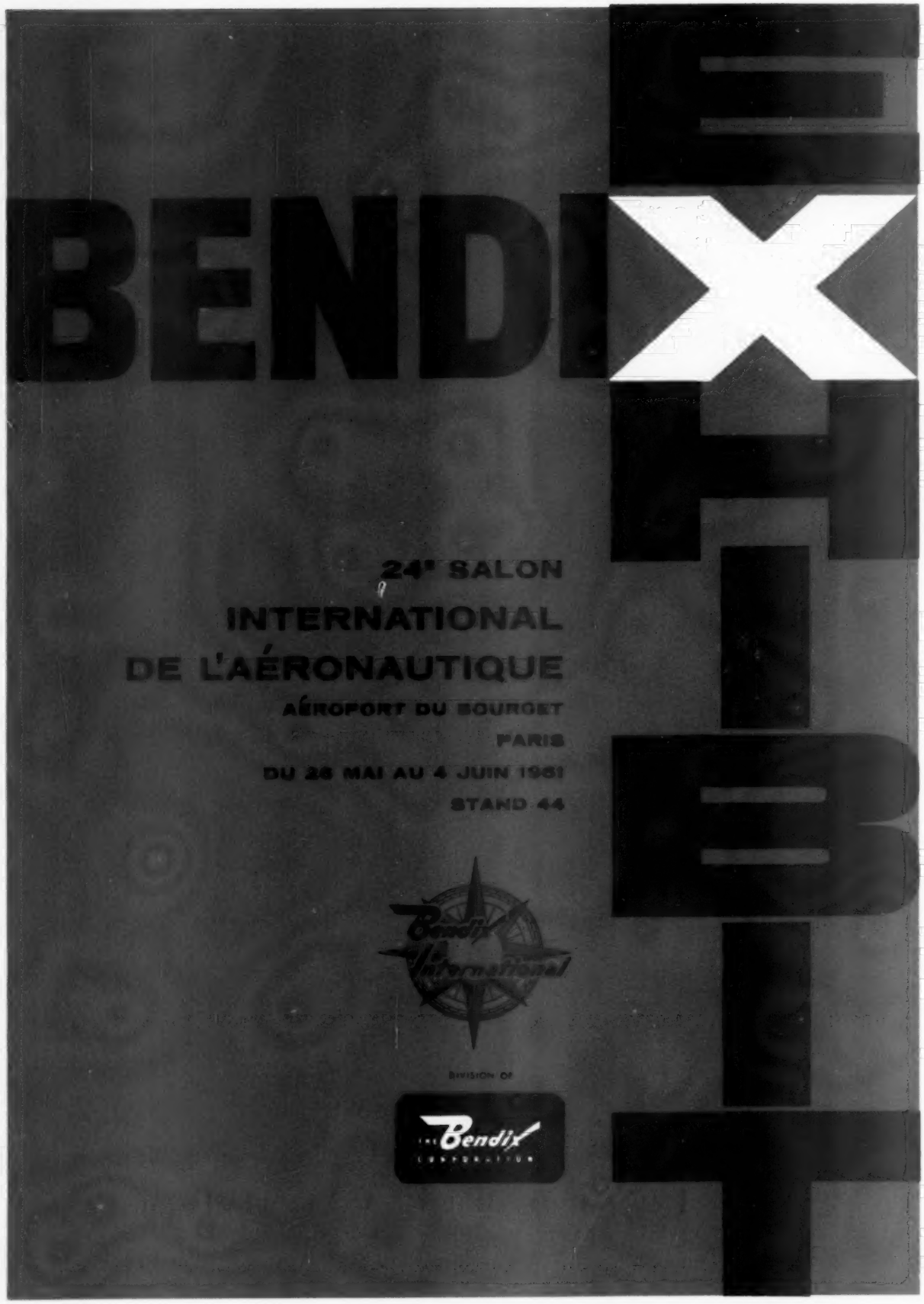

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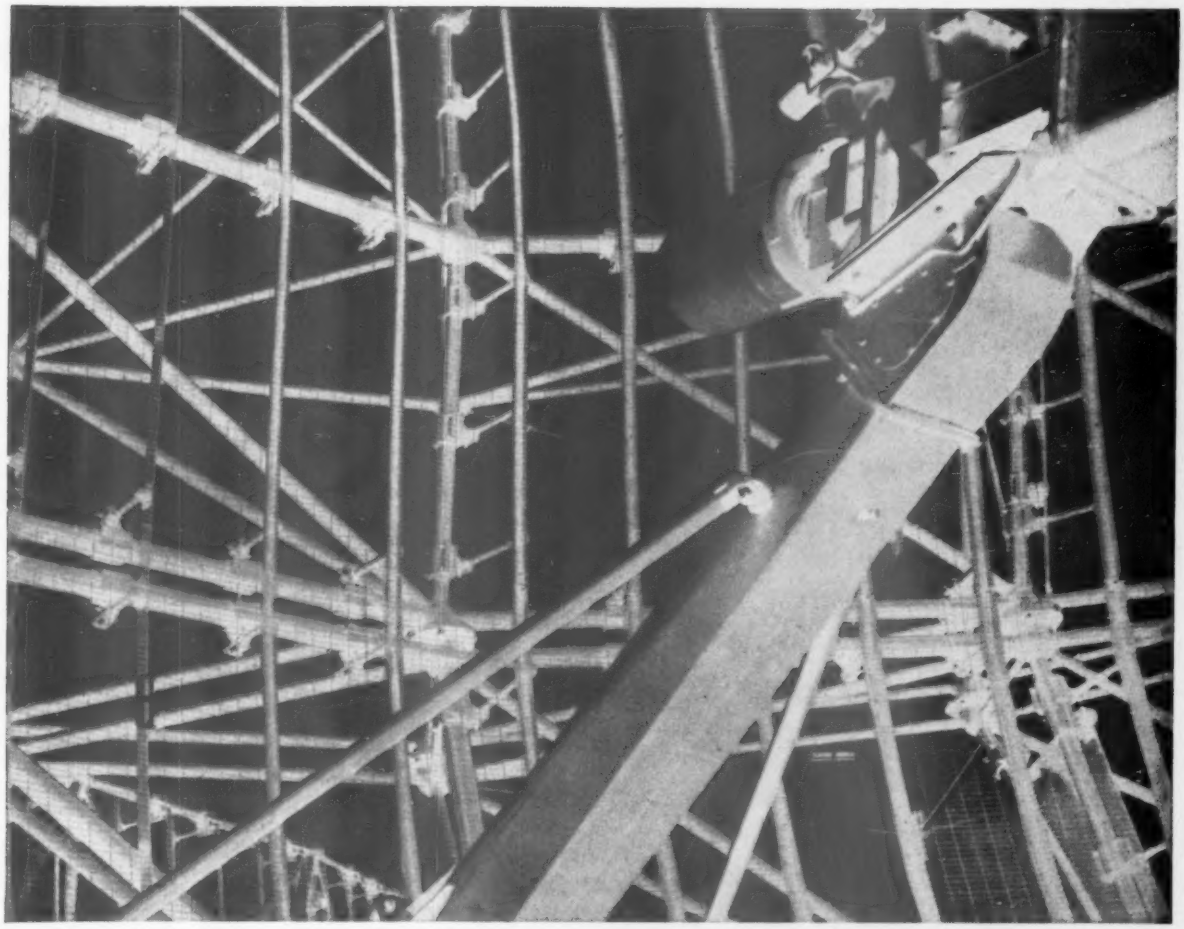

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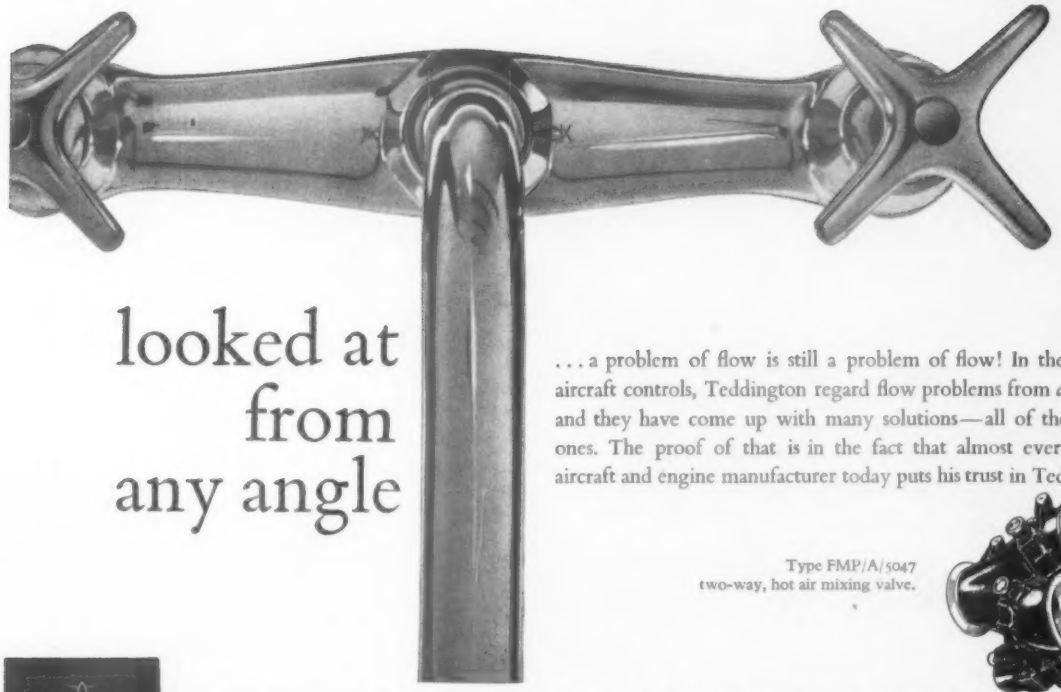

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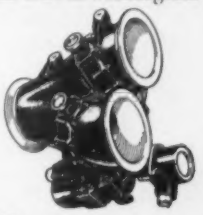

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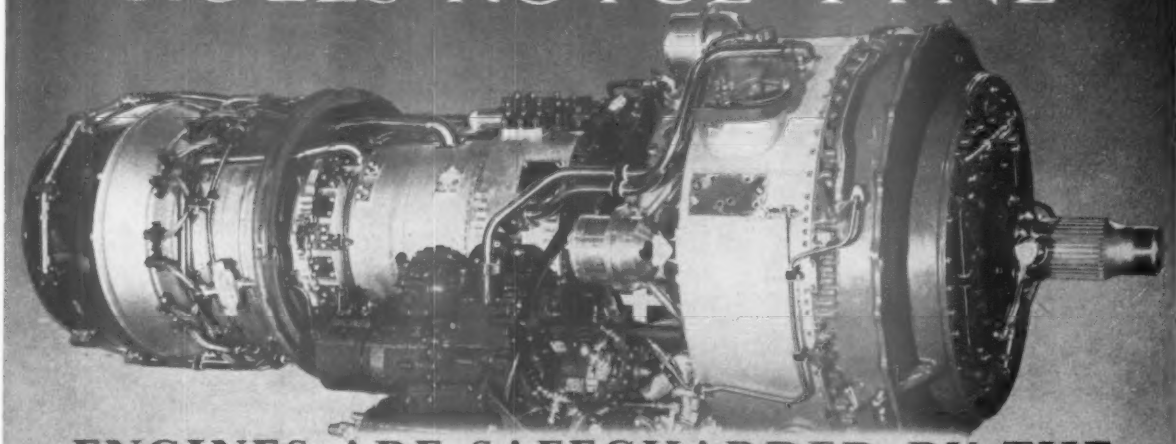

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THE AEROPLANE and ASTRONAUTICS

VOLUME 100 NUMBER 2584 APRIL 27, 1961

London-Budapest

Standing in the control tower at the Ferihegy airport at Budapest and watching a Comet of United Arab Airlines being brought into land is an educative experience, and withal a stimulating one. The language used by controller and captain alike is English. Should it be necessary to use the ILS, the equipment is English and at night the aircraft are brought in by the Calvert lighting system. One finds that the Hungarian authorities are lavish with their thanks for the help received from International Aeradio, Ltd.

Facts of this nature are much more revealing about the broadening effects of international trade than sightseeing tours meticulously organized and slanted to show off specially selected features of a country's economy. Hungary as a country of some 10 million people and few natural resources in so far as raw materials are concerned cannot be expected to have much money to spend abroad. There are some things however among her exports which people in this country are going to want more of, as for example, wine. And there are increasingly specialized products from the fast-growing industrial section of the economy.

Thus the opening of the B.E.A. service between London and Budapest last week and the concomitant arrival this week of a Hungarian delegation to be led by Mr. Rudolf Ronai, director of civil aviation, on the inaugural Malev (Hungarian National Airline) service is to be welcomed as making business communications between the two countries easier. A more one-sided traffic is to be expected in tourist travel. Those who have recently had the good fortune to spend some days in Hungary as official guests have been able to sample for themselves the unique characteristics of Hungarian food and wine. In the fields of recreation and national antiquities there is much to enjoy also. It is not hard to imagine a growing tourist traffic to Hungary.

Snail's Pace in Montreal

Probably no Technical Conference in the history of the air operators' International Air Transport Association has received as thorough advance organization or widespread preliminary discussion as the Fourteenth of the series which was held in Montreal last week. But participants did not indulge in the discussions at supersonic speed. Their deliberations were keyed to the activities of the tortoise rather than those of the hare. This may well be a presage of things to come. It was, was it not, the persistent tortoise who won the race? In case our parable is not sufficiently explanatory, let us regard the operators as having the desire to avoid being rushed into a similar situation to that encountered with the advent of the jet transport.

The trend of the discussions is reported by our representative who was present throughout. And at this stage there seems nothing to be gained by adding to his comments, except perhaps in one case. Mr. Brancker observes that in some respects the problems being posed are exactly the same as those facing the industry now and should be solved for the present generation of aircraft. Forcefully he declares that they are not new; they have merely been neglected and will become more vicious in the supersonic age.

World Air Transport cannot afford to wait 10 years for the experts to solve air traffic control, passenger handling and automatic landing problems. These require something better than to progress at snail's pace.

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Editorial, Advertisement and Publishing Offices:
BOWLING GREEN LANE, LONDON, E.C.1

Telephone: TERminus 3636
Telegrams: "Pressimus London Telex"
Telex: 23839

Annual Subscription Rate: United Kingdom £4 15 0
Overseas £5. Canada and U.S.A. $15.00

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Matters of Moment

European Space Technology

A LEADING part in drawing together the engineers and scientists of Europe interested in formulating a joint programme of space technology is being taken by the British Interplanetary Society. As part of its endeavours, the Society is to hold a three-day "European Symposium on Space Technology" in London from Jne. 26-28, 1961. The conference will have heavy industrial overtones and will discuss the most fruitful lines of approach, bearing in mind the resources in men, money, and facilities. Particular emphasis will be given to:—

(1) Future trends in the development of spaceflight, particularly a review of future possibilities to Western European capabilities, but taking into account advanced studies which need not require very considerable budgets, for example, structural and propulsion problems, control engineering, etc.

(2) Applications of space technology in the civilian field, for example, communication, meteorological, and navigation satellites.

(3) The effect of space technology on the present structure and level of industry, particularly of an international nature, with consideration of political and economic aspects.

The Society has emphasized that the symposium will differ to some extent from normal events of this sort which consist only of the presentation of technical papers. On this occasion an opportunity is being taken to promote discussion, pose problems, and to ascertain to some extent the probable lines of development both in international politics and industrial collaboration. In addition, it is hoped that the conference will widen the appreciation that a new surge of technical progress is gathering momentum under the stimulus of astronautics.

A Piaggio-Douglas Jet Executive

DOUGLAS AIRCRAFT CO. and Piaggio have concluded an agreement for the joint development by the two companies of a six-seat twin-jet executive and general purpose transport. Known as the PD-808, this is based on a design study by Douglas; the basic configuration is being completed at the company's El Segundo division. Piaggio will be responsible for detail design and for construction, with assistance from Douglas. Two prototypes are to be built, the first to fly in 1962.

No details of the design have been given, except that it will be powered by two turbojets or turbofans of up to 3,000 lb. thrust each, will cruise at 500 m.p.h. at 40,000 ft., and will have a pressurized fuselage. Market studies, say Douglas, "confirm an increasing demand by both government and private business for light, utility jet aircraft of this type."

Douglas has an option to become the exclusive agent for sale and servicing of the PD-808 throughout most of the World, excluding Italy and some other European countries, and the right to build the aircraft for U.S. Government agencies, if ordered. Production by Douglas will also be permitted for commercial customers after Piaggio has sold a specified quantity.

The PD-808 is the fourth aircraft in this class now being built in Europe. The others are the de Havilland D.H.125, the SAAC-23 and the Israel B.101C (see our issue for Apr. 13). Of these, the D.H.125 and B.101C are exclusively national projects, while the SAAC-23 is a U.S.-Swiss venture promoted by William Lear, Snr. Another project in a similar category is the Saab 105, expected to be shown in model form at the Paris Aero Show next month and intended primarily as a military or airline trainer. In this category, too, the North American T-39 Sabreliner is already in production and is soon to be certificated for commercial use. It, too, will be seen at Paris.

Cranfield Graduates in Demand

DESPITE being the thirteenth in the series—and held on a Friday—this year's annual Senior Common Room Dinner at the College of Aeronautics showed no evidence, last week, of any unhappy influences. Indeed, it followed its splendid tradition of being a most enjoyable occasion and, as usual, it was a great gathering of aeronautical personalities—among whom it was good to see Sir Frederick Handley Page, chairman of the board of governors.

As the principal guest observed in his toast to the senior common room, Cranfield is a place where aviation science and education are energetically pursued. Certainly, on these occasions there is always plenty of evidence of the enthusiasm members of the Cranfield staff have for the part they play in Britain's principal seat of learning devoted to postgraduate studies in aeronautical engineering.

In a stimulating address, MR. M. J. LIGHTHILL, F.R.S., Director of the Royal Aircraft Establishment, remarked on the close collaboration that exists between the R.A.E. and the College. He spoke, too, of the opportunities for them to work closely together on research because of the proximity of the Establishment's Bedford branch to Cranfield.

After speaking of the number of Cranfield graduates that are embarked on a successful career at the R.A.E., he referred to the Establishment as a very satisfied customer of the College. It was obvious, he went on, that other customers were equally well satisfied. He had something to say, however, about the—at times—disappointingly short supply of trained aeronautical engineers. In this context he commented on the influence in this respect of the 1957 White Paper which had given an incorrect impression of value of a career in aviation.

Mr. Lighthill said he was impressed by the College's diversification policy; one-year courses were educationally sound. The College, he thought, had something in common with industry,

EXPORT POTENTIAL.—According to recent reports, Westland Wessex helicopters powered by Napier Gazelle shaft-turbine engines have been selected for service by the Royal Australian Navy for anti-submarine duties. A figure of 30 aircraft at an estimated value of £A9 million has been quoted. This order is said to be subject to approval by the Australian Government.

IN BUDAPEST.—Lord Douglas, chairman of B.E.A. followed by Pipe Major R. Crabb and Piper J. MacDonald of the Scots Guards, after completing the laying of a wreath on the Unknown Soldier's grave in Red Hero Square on Apr. 20.

Photograph copyright "The Aeroplane and Astronautics"

in going beyond the sphere of aviation in its diversification programme.

In reply, PROF. A. J. MURPHY, M.Sc., F.I.M., F.R.Ae.S., said how encouraging he found Mr. Lighthill's comments. Cranfield was in an isolated position and there was a danger that it might become educationally isolated. On the subject of the principal guest's "cogent remarks" about the 1957 White Paper, Prof. Murphy said that this had had no effect on the College entry for two years. Then there had been a falling off, last year, for the diploma course; but there had been a corresponding increase in the entry for their diversified courses.

He was certain that enrolment for the diploma course would increase again. The demand for Cranfield graduates was greater than ever before. Eventually the shock of the 1957 White Paper would be overcome.

Concerning the shortage of trained men he said that one company had reacted to the insufficiency in supply by selecting its own men straight from universities and sending them to the College for a year's intensive course on aeronautical engineering.

At the present time there were 149 students working for their diplomas and 62 working on one-year courses. It could not be said that diversification had caused neglect of the aeronautical courses because in 1954-55 the sum spent on aeronautical subjects was less than half that spent in 1960-61.

The toast to the guests was most entertainingly proposed by MR. SEYMOUR HILLS, M.A., F.R.Econ.S., F.Inst.W., M.I.O.M., director of the College's Work Study School. SIR HAMISH MACLAREN, K.B.E., C.B., D.F.C., LL.D., B.Sc., M.I.E.E., Director of Engineering at the Admiralty and President of the Institution of Electrical Engineers, replied. He expressed the thoughts of all the guests when he spoke warmly of the College's excellent hospitality—after which he went on to produce some extremely interesting personal reminiscences about First World War aircraft.—F.T.M.

Aboard the Vostok

FURTHER details of Major Gagarin's orbital flight were given in the newspaper *Izvestia* on Apr. 24. The Vostok spacecraft is described as being constructed in two parts, following the practice of the earlier dog-carrying vehicles. One part housed the pilot, pressure cabin and landing equipment and the other the retro-rocket and equipment needed in orbit.

The article explains that after the spaceship had descended to a certain height, "the landing apparatus can be switched on, and the landing of the pilot's cabin takes place at low speed.

"The landing of space pilot can take place in the cabin of the ship. Such a landing method was tested on the fourth and fifth Soviet spaceships.

"A variant on this was also foreseen in which the pilot would be expelled by ejector seat at a height of about four miles, and would land by parachute.

Another important point explained in the article is that the Vostok carried sufficient food, water, oxygen and electrical supplies to keep the astronaut alive for up to 10 days. Had the retro-rocket failed to ignite at the appointed time, re-entry would have occurred as a natural result of atmospheric retardation.

Izvestia also explained that the Vostok had three viewing ports and two escape hatches. One of the viewing ports was fitted with "direction finding apparatus" to enable the pilot to establish his position if ground control failed. A photograph of the cabin interior shows the following equipment: Pilot's controls instrument panel with revolving globe, indicating the ship's position; a TV camera facing the pilot; a viewing port with direction finder and orientation handle; a radio receiver and a food container.

All of which, as we suggested last week, follows what was to have been expected from the publication of details about previous successful and unsuccessful attempts.

Gagarin or Ilyushin?

LAST week-end there was much speculation over a French report that Major Yuri Gagarin was the second and not the first man to orbit the Earth. According to M. Edouard Bobrovski, a French radio commentator lately returned from Moscow, Gagarin was preceded by no other than Serge Ilyushin, son of the Russian aircraft designer. Although the capsule returned to Earth in one piece, the man inside it "was completely unbalanced and doomed," Bobrovski asserted. Ilyushin was now "in a coma in a Moscow hospital."

M. Bobrovski claimed that Ilyushin's flight had taken place three or four days before Gagarin's, and also that he had circled the Earth three times.

Some credence was given to this story by a *Daily Worker* report—published just before Major Gagarin's mission on Apr. 12—that a test pilot, who was the son of a top Soviet aircraft designer, had been in orbit but was understood to be suffering from after-effects.

There are at least two good reasons for doubting the authenticity of this report. The first is that American tracking stations, always on the alert for Soviet space launchings, do not appear to have picked up a rocket leaving the U.S.S.R. and going into orbit. If a spacecraft had circled the Earth three times, this would have provided ample opportunity for radar tracking and, of course, the final stage of the carrier rocket would have remained in orbit after the spacecraft itself had re-entered.

Second, because of the Earth's eastward rotation, a space flight lasting three orbits would have entailed recovery outside the appointed landing area in the U.S.S.R. Gagarin was, it will be recalled, recovered after the first orbit.

Spare-time Cushion-rider

A SMALL research air-cushion-riding craft has been built at Redhill by students of the College of Aeronautical and Automobile Engineering in their spare time. It was designed by Mr. Donald R. Robinson and is called the Skimmer. The vehicle is 11 ft. 6 in. long and is powered by a 40-h.p. Johnson outboard motor driving a large centrifugal fan via a vertical shaft and clutch. Air is ducted to the outer edge of the machine and directed inward beneath it at 30°.

It was designed as a single seater and has a 4-5-in. hover height with one person aboard, but still clears the ground with five people up. Cost of the Skimmer, apart from its engine, was £70 for materials and it took some 250 man-hours to build. It was designed to obtain first-hand experience of hovering and to investigate the effects of different control methods.

Directional control of the vehicle is by a rudder-bar which moves 40 small blades in the main duct. Movement over the ground is made by tilting the machine in the required direction. It is said to be very sensitive to centre-of-gravity movement and the "driver" has an additional measure of control by leaning in the desired direction.

MIGHTY TEST STAND.—Nearing completion at Edwards A.F.B. in California is this test-stand for the 1.5 million-lb. thrust single-chamber-Rocketdyne F-1 rocket engine being developed for NASA. The stand is more than 250 ft. high and will accommodate two F-1s; it can be expanded to handle a cluster of four. Note man at the bottom (arrowed).

A Second U.S./U.K. Satellite

AGREEMENT has now been reached between NASA and Great Britain concerning the payload for the second scientific satellite in the co-operative programme. This is expected to be launched by an up-rated four-stage Scout rocket from Wallops Island, Virginia, sometime in 1963. The first U.S./U.K. satellite—the S-51—is scheduled for launching early next year.

All the scientific instruments contained in the second satellite, as in the first, will be designed and built by British scientists and appropriate industrial contractors. As we forecast in our issue of Dec. 2, 1960, the experiments will have a three-fold purpose. It is intended to measure the ozone content of the upper atmosphere; to study the distribution of micrometeorites; and lastly to investigate radio emissions from the galaxy at wavelengths too long to penetrate the Earth's atmosphere.

Measurement of atmospheric ozone will involve two methods: both will be in the hands of Dr. R. Frith and Dr. K. H. Stewart of the Air Ministry Meteorological Office in London.

Measurement of the micrometeorite flux is being studied by Dr. R. C. Jennison of the Nuffield Radio Astronomy Laboratories, University of Manchester, Jodrell Bank, Cheshire.

Investigation of galactic noise in the frequency range 0.75-3 Mc/s., and the exploration of the upper ionosphere, will be conducted by Dr. F. Graham Smith of the Mullard Radio Astronomy Observatory of Cavendish Laboratory, Cambridge.

The orbit of the satellite, varying between 186 and 1,200 miles, is expected to pass over the United Kingdom and the United States. It should be possible to receive telemetered information in these countries and at stations in the British Commonwealth.

Faster Still

ON Apr. 21 a North American X-15 research aircraft piloted by Maj. Robert White reached a new record speed of 3,140 m.p.h. after being dropped from its mother aircraft at 45,000 ft. over the Californian desert. This speed was reached in a climb to 103,000 ft.; the aircraft's XLR99 rocket motor was run for 67 seconds.

It would seem that this motor is still not as reliable as it might be. On this latest occasion it failed to fire immediately after the X-15 was dropped, and the aircraft descended 10,000 ft. before the motor ignited.

However, despite difficulties with the rocket engine, the X-15 programme has made impressive progress recently. The highest speed reached before the latest flight was 2,905 m.p.h. achieved by the X-15 on Mar. 7. The X-15 also set up a height record of 169,600 ft. less than one month ago on Mar. 30. (When the article on page 460 of this issue went to press, news of this latest X-15 achievement had not been received and the data quoted in it, therefore, refers to the lower speed of 2,905 m.p.h.)

A. B. H. Youell

A GREAT many people—and particularly those concerned with air transport in the inter-War years—will have learnt with regret and initial disbelief of the death, in a helicopter accident in Ethiopia, of that veteran British pilot, Capt. Alan Bruce Hamilton Youell. He was flying a helicopter on survey work with two passengers about 175 miles north-west of Addis Ababa when the accident occurred.

"Jimmy" Youell, who was born in 1900, had been actively engaged as a pilot since 1917, when he learnt to fly with the R.N.A.S. He was a captain with Imperial Airways from 1923 to 1940 and served with R.A.F. Transport Command from 1942 to 1945. After the War he became a specialist in helicopter work. He had flown well over 20,000 hr. as a pilot.

WAGGING ITS TAIL.—Celebrating the first flight of the new Beagle-Auster four-seat A.109 (one 180 b.h.p. Lycoming), the team at Rearsby pose with Mr. P. G. Masefield (centre) in front of the new aircraft—of which the distinctive new back-swept fin can just be seen.

PATCHWAY VISITORS.—Three new British air attachés visited Bristol Siddeley's Patchway works recently to see the company's production and test facilities. Left to right, here, are: J. M. Porter of the company's Aero Sales department; Gp. Capt. J. R. Gard'ner, air attaché designate, Brussels; P. Little, B.S. project engineer; Wg. Cdr. Digman, air attaché designate, Djakarta; and Gp. Capt. J. C. Button, air attaché designate, The Hague.

No Reason for Doubt

SOME encouraging views on the future of the aircraft industry generally and of Folland Aircraft in particular were expressed recently by Mr. D. G. Brade, a director and general manager of the company. He was speaking at the annual distribution of prizes to apprentices at Hamble.

After referring to the youthfulness of the aircraft industry he remarked that like all young things it had taken some hard knocks—a major one recently being the Government White Paper of 1957. "You will recall," he said, "the Government's drastic cut in expenditure, and its effect upon the aircraft industry as a whole.

"The industry," he went on, "has, however, fought back hard, and has surmounted practically all the difficulties and obstacles that arose through that action. Aircraft manufacturers have now achieved a productivity with a future almost second to none, with both civil and military contracts.

"The legacy of this White Paper, however, remains with us even today in a somewhat spectral form. It did at the time cast doubts—very far reaching doubts—upon the future of this industry. Young men, and also trained and experienced men, looked askance at aircraft. Education bodies tempered their previous enthusiasm with caution and deflected the almost dedicated aeronautical students to other spheres, so much so that our own Southampton University—an aeronautical stronghold—is even now concerned at the lack of young men enrolling to read aeronautics.

"This spectre of the past, although now fading rapidly, still rears its head from time to time and casts a doubt in the mind of embryo aeronautical engineers. . . ."

So far as the Folland company was concerned, Brade said that it had had a "few knocks" in the past two or three years, but it hoped that it had learnt something from each. The present position of the company, he said, was stronger than ever it had been before.

It had an intensive programme of work on contracts for both military and civil aircraft operating throughout the factory as a whole. He felt certain that present orders for the Gnat Trainer and the Avro 748 wings were by no means the last. "In fact we are confident of considerable additions to both contracts."

The Folland GERM air-cushion-rider and other projects were rapidly taking shape and it was hoped that in the comparatively near future it would be possible "to report further advancement and achievement in these new fields."

Russian Test Pilots Honoured

A UKASE of the Supreme Soviet on Mar. 14 announced the award of the title of "Honoured Test Pilot of the U.S.S.R." to nine Soviet pilots. Among them was Col. A. K. Starikov, who made many of the original Tu-104 proving flights, including several to England in 1956. His work was said to have made "a large contribution to the progress of Soviet aviation."

Another recipient of the award was Engineer-Colonel N. P. Zakharov, who did much of the early development of the present Soviet radar for fighters. He has flown 62 types of aircraft and his total hours are 1,736.

In the list is Hero of the Soviet Union, G. T. Beregovoi, who has many exploits to his credit, including an incident when his tailplane control became stuck at a speed of just over Mach 1; Beregovoi recovered full control at only 650 ft.

Col. E. V. Golenkin tested a "jet bomber" in 1951 (presumably the Il-28) and was a leading test pilot in the early test flights of the Il-18; he has 4,029 hours to his credit.

Hero of the Soviet Union, Col. V. K. Grechshkin has taken part in more than 35 test projects. Hero of the Soviet Union, Col. N. I. Korovushkin has flown 2,158 hours and has 52 types in his log book; he was one of the earliest Soviet high-altitude and high-speed pilots. Hero of the Soviet Union, Col. V. S. Kotlov has been flying for 22 years, 10 of them on test flying.

The other two pilots honoured were Hero of the Soviet Union, Col. M. S. Tvelenev and Lt.-Col. L. N. Fadeev.

Air Matters in Parliament

Assignment of Fighter Command to NATO

ON Apr. 12 the House of Commons learned from MR. HAROLD WATKINSON, Minister of Defence, that he is actively implementing the decision taken last year by the North Atlantic Council to integrate Fighter Command into the North Atlantic Treaty Organization air defence system. In reply to MR. F. F. A. BURDEN (Con., Gillingham), who had asked him to make a further statement on the project, he announced that as a next step he is arranging for Gen. Norstad to be given formal notice of the assignment of Fighter Command to NATO, such assignment to take effect from May 1. This, he said, will improve the air defence capability of the whole area, including the United Kingdom.

In some earlier words of MR. J. RANKIN (Lab., Govan), he said, this is "an attempt to provide defence in depth." We now get the great advantage of the forward radar coverage and fighter screens far further forward on Europe, as part of the general NATO air defence system.

The Fighter Command forces assigned to SACEUR will be the air defence fighter squadrons and the operational units of the Bloodhound Mark 1 S.A.G.W. system, and of the control and reporting system.

Air Marshal Sir Hector McGregor, A.O.C.-in-C., Fighter Command, is being nominated for appointment by SACEUR as Commander, United Kingdom Air Defence Region. SACEUR's responsibilities for air defence in the United Kingdom Region will be exercised through the Commander.

In reply to a further question, Mr. Watkinson said he wished to make it plain that the size, composition, rôle and deployment of those forces now to be assigned to SACEUR will remain matters for our own decision, and that NATO can in no circumstances deploy Fighter Command aircraft overseas without express permission of the Government.

On the face of it there seems no reason why such a disposition should not work admirably in practice. Whereas it has been generally conceded that present-day defence strategy demands some form of unified control, concern was expressed in some quarters that an international overriding authority would tend to absorb its component members, and that in consequence Fighter Command might lose its identity. Now happily this bogy seems to be laid by the saving reservations recited.

Retaliation—Not Aggression

Some misgiving is still voiced as to just what circumstances might induce the Western powers to unleash the devastating weapons now at their command. For its very conciseness, therefore, a further utterance by the Minister of Defence during the same session is apposite. Replying to a question by MR. S. T. SWINGLER (Lab., Newcastle-under-Lyme) he quoted verbatim President Kennedy's dictum—"Our arms will never be used to strike the first blow in any attack"—and continued: That is also the policy of Her Majesty's Government. . . . The Government's position is plain and has been made so on a great number of occasions. We will retaliate to any aggression with whatever force we deem necessary in any particular set of circumstances.—O. W. H. COOKE.

Supersonic Conference—A Sluggish Start

Some 650 delegates from 137 airlines and other organizations from 25 countries had agreed to participate in the Symposium on Supersonic Transport Aircraft which opened on Apr. 17 in Montreal. This specially commissioned report is by JOHN BRANCKER, *IATA's Traffic Director* 1953-60.

PERHAPS the most important thing about the IATA "Symposium on Supersonic Air Transport" which started here in Montreal on Apr. 17, is that it has happened.

No one can claim that they have not been warned—if, indeed, any warning were necessary. Even the oratory which marked the official opening lacked its usual flamboyance, and all speakers included notes of caution. This aspect was stressed particularly by Mr. Walter Binaghi, president of the council of ICAO, who made a general statement of ICAO's views at the start of the first closed session.

Among other things he pointed out quite firmly that supersonic transport aircraft would have to be capable of operation from existing airports; neither carriers nor manufacturers could expect major runway extensions. It would also take time for governments to design and install the new equipment needed for communications and air traffic control. In this context he made the point that although subsonic jet equipment had been introduced before many of the proper facilities were available, albeit at some loss of efficiency, it was probable that carriers would be prohibited from operating supersonic aircraft until the authorities were satisfied that the necessary facilities did exist.

He also made the point that the competitive position could not be overlooked, and that certain governments might well adopt a restrictive attitude to protect their own national operators if they themselves could not join in the race.

All very logical and good sense, but past experience has shown that even given adequate warning, the authorities have usually only been induced to provide facilities when services are already in operation and it has become quite imperative to do so. It has nearly always needed an accident to get improvements in air traffic control.

Although this particular Technical Conference seems to have attracted more interest than any previous one, the amount of real enthusiasm for the project under discussion is strictly limited. The exceptionally large attendance may well be due to nervousness rather than to a basic desire to bring in supersonic transport as quickly as possible.

The airlines generally appear to be somewhat like children on the way to school, hoping that something will happen to prevent it, but feeling that it is ultimately inevitable.

The important thing, however, is that the meeting is taking place, and under the very able and sensible chairmanship of Jack Dyment of T.C.A. the carriers are showing more clearly than they have in the past that they are not going to accept a vehicle which will not give them a chance of economic survival or which may make them unpopular with the public or the authorities.

Splendidly Organized

The points to be covered by a symposium of this nature are legion, and Stan Krzyczkowski and his staff are to be congratulated on the way in which the affair has been organized and the paperwork produced. There is, however, no cure for bulk, and it is very doubtful whether there is enough time available to touch more than superficially on many of the matters to be discussed. This may be inevitable, but if nothing else is achieved all concerned will realize the size of the problem and the vast amount which remains to be done.

In this context the discussions on the floor give the impression that there is, in fact, very little basic knowledge available, even on such fundamental matters as the strength and life of various metals at the temperatures to be encountered. This may be due to two reasons; a reluctance at this stage to make statements which may not prove to be correct in the light of later experience, and possibly to the fact that such information, while available, is classified and cannot be made public. Individual manufacturers, moreover, are wary of disclosing facts which may be useful to their competitors.

One of the most interesting discussions took place in connection with the noise problem. It is undoubtedly extremely important because it may not only determine the type of power plant to be used, dependent as it is on the altitude at which the aircraft is permitted to go transonic, but also because, unless solved, it may prevent the use of supersonic transport aircraft altogether.

Here there seems to be a lack of precise knowledge on two counts; first the maximum tolerable figure which could be accepted for a "sonic boom" and secondly what sized boom a supersonic transport aircraft is likely to make. On the first count a figure of 1 lb./sq. ft. or 128 db. was quoted; described as the noise heard if one held one's head approximately 2 ft. from a bass drum. Certain representatives felt that it might not be possible to hold the sonic boom even to these dimensions and mentioned figures in the region of 1½ lb./sq. ft.; others felt that even a figure of 128 db. was too high. The airlines are patently very sensitive on the subject of sound and are wholly unwilling to let themselves in for a vehicle which may be very restricted in its use.

Noise—A Matter of Education?

Broadly speaking, the manufacturers were of the opinion that the public could be educated—a view which did not find much support elsewhere. An apt point was made that it might be difficult to educate the public of a country which would be overflown but which might have no interest itself in supersonic transport, and two speakers mentioned the fact that even over areas where there was no human habitation, some governments at least would prohibit flight if it disturbed wild animals. Animals on the other hand may be more resilient than supposed. Birds lodging in places where they are not wanted—particularly airports—are remarkably undisturbed by noise.

It was also pointed out that there was no object in accepting a high value on the basis of infrequent occurrence, because increasing traffic would have to be taken into account. The intensity of the sonic boom may vary considerably according to weather conditions and the upward scatter could be 50% above the norm. While the consensus of opinion was that supersonic aircraft could pass each other without doing each other damage, the wretched individual on the ground would get a double dose and might well need a new greenhouse. When the possibility of confining operation to overwater routes was mentioned, there did not appear to be a great deal of sympathy for ships, which are regarded as less vulnerable than houses, although this view did not go unchallenged.

This is certainly a problem to be solved if the supersonic aircraft is to be successful, but there is at least one organization, NASA in the United States, which appears ready to spend considerable time and effort in finding a solution. There is no doubt that some of these problems, to which there is no immediate solution apparent, will be used as an excuse for a good deal of dragging of feet on the part of some interested parties, and this would be wholly unwise.

Most of the representatives have come to listen rather than speak. In the first two days the chairman has had to work hard to elicit views and promote discussion.

There has not yet been a direct clash over the thorny problem of the Mach number to be aimed at and whether this should be nearer 2 or 3, but replies to other questions have been slanted to emphasize the advantages of the particular number favoured by the speaker.

Most airlines expect an aircraft life of at least 30,000 hours, but hope for more and a utilization figure of about 3,600 hours per annum for a Mach 2 aircraft and 3,200 hours per annum for Mach 3. Those who spoke were clearly insistent that any supersonic aircraft would have to show the same costs per seat mile as for current subsonic jet equipment—or lower.

The size of aircraft presented considerable problems, because some manufacturers indicated that the general rule—"the bigger the aircraft the lower the seat mile cost"—might prove even more true of supersonic aircraft than in the case of subsonic equipment, and this would immediately conflict with the need for high utilization and the general principle that the shorter the duration of the journey the greater the desirable frequency.

Maximum size may well be limited by runway bearing strengths, but there is going to be a lot of soul-searching about frequencies.

General discussions centred on aircraft with a passenger capacity between 100 and 130 and an all-up weight between 300,000 and 350,000 lb. The idea of having two different sizes of aircraft was not received with much joy by the manufacturers.

The airlines were virtually unanimous in wanting to retain the ability to sell two different classes of service on the same aircraft and were also insistent that the seating in first class should be four abreast. It was clear from the manufacturers' comments that, because of the need to adopt a fineness ratio of 14 to 1, the maximum number of seats which could be fitted abreast, in the type of aircraft being considered, would be five, even for coach or economy class. So perhaps that will be one question less for IATA to argue about in future. It was, of course, only the inherent width of the big jets which made it necessary for six-abreast seating to be adopted to accommodate the load. Volume is going to be even more valuable on the supersonic aircraft, but some carriers at least were fairly insistent that space should be made available for mail and cargo at premium rates.

In considering range, the carriers appeared to take the view that they should continue to be able to fly the non-stop services which they operate at present and some were ready to settle for a requirement of 3,500 nautical miles. Longer ranges may not only add appreciably to cost but may also penalize the aircraft when used over shorter sectors. Most of the studies made by manufacturers seems to have been based on average sectors of 2,000 miles, but one at least felt that a few shorter sectors of about 1,000 miles might be included in a route network, but not too many. One manufacturer said that in his opinion an aircraft could be built to operate over ranges between 600 and 1,800 miles but did not describe how.

In discussing speed a good deal of attention was intelligently directed to the considerable difference between supersonic cruising speed and effective "block" speed. One carrier pointed out that with a Mach 3 aircraft the "block" speed on a transcontinental flight was in fact 1,200 m.p.h. This, of course, is quite apart from the time taken by the passenger in travelling from the city to the airport and *vice versa* and being ground slowly through the formalities of Customs and immigration; a most worthwhile point, which raised the usual plea for improvement but is, of course, just as valid with the present generation of aircraft as it will be when supersonic aircraft are introduced.

Faster aircraft will merely make the present processes look even more ridiculous than they do today.

A committee of the conference has been established to examine the whole problem of ground handling in so far as supersonic aircraft are concerned, but it is, in fact, immediate action which is necessary.

A slightly rhetorical but pertinent question was asked during the session—"Would it perhaps be wiser to spend money on providing monorail connections between cities and airports instead of developing supersonic aircraft?" Worth thinking about, but the answer must surely be "Both." There are still about 10 years to go before the supersonics are in service, and the passenger needs his better facilities now.

It is, of course, much too soon to start trying to reach any conclusions about the results of the symposium.

In some ways the problems being posed are exactly the same as those facing the industry now, and should be solved for the present generation of aircraft. They are not new; they have merely been neglected and will become more vicious in the supersonic age. I refer in particular to those concerned with air traffic control, communications, automatic landing, ground handling, etc.

In other respects there does not seem to be a full realization of the completely different sort of services which the new aircraft will provide or of the radical changes in outlook which will be necessary to make them possible or profitable. Perhaps this particular meeting will help to start the right sort of thinking.

PARTICIPANTS AT THE CONFERENCE

AIRLINES

Aer Lingus
Aero O/Y (Finnair)
Air France
Air-India International
Alitalia
American Airlines
Braniff Airways
British European Airways
British Overseas Airways Corporation
C.S.A.
Delta Air Lines
Deutsche Lufthansa
El Al Israel Airlines
Iberia
Indian Airlines
Japan Air Lines
KLM Royal Dutch Airlines
Middle East Airlines
Olympic Airways
Pakistan International Airlines
Pan American-Grace Airways
Pan American World Airways
Philippine Air Lines
Qantas Empire Airways
Sabena Belgian World Airlines
Scandinavian Airlines System
South African Airways
Swissair
Trans-Canada Air Lines
Trans World Airlines
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VARIG

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Belgium
Belgian Régie des Voies Aériennes
Brazil
Brazilian Diretoria de Rotas Aéreas
Canada
Canadian Defence Research Board
Canadian Department of National Defence
Canadian Department of Transport
Canadian National Research Council
Royal Canadian Air Force
Denmark
Danish Directorate of Civil Aviation
France
French Secrétariat Général à l'Aviation Civile
Germany
German Directorate of Civil Aviation
Netherlands
Netherlands Directorate of Civil Aviation
Philippines
Philippines Civil Aeronautics Administration
Portugal
Portuguese Direcção geral da aronáutica Civil
South Africa
South African Directorate of Civil Aviation
Spain
Spanish Dirección General de Aviación Civil
Sweden
Swedish Research Institute
Swedish Royal Board of Civil Aviation
Switzerland
Office Fédéral de l'Air
United Kingdom
Air Registration Board
Ministry of Aviation
Royal Aircraft Establishment
Royal Air Force
United States
National Aeronautics & Space Administration (NASA)
U.S. Air Force
U.S. Civil Aeronautics Board
U.S. Federal Aviation Agency
U.S. Radio Technical Commission for Aeronautics
U.S. Weather Bureau

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Nord Aviation
North American
Pratt & Whitney Aircraft
Republic Aviation
Rolls-Royce
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EQUIPMENT MANUFACTURE AND DEVELOPMENT

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Airborne Instruments Laboratory
American Bosch Arma
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Hazeltine Electronics Division
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International Business Machines
Kollsman Instrument
Laboratory for Electronics
Lear
Minneapolis Honeywell
Motorola
Northrop
N.V. Phillips' Telecommunicatie Industrie
Plessey
R.C.A.
Royston Instruments
Smiths Aircraft Instruments
Sperry Gyroscope Company
Standard Telephones & Cables
The Bendix Corporation
The Marquardt Corporation

INTERNATIONAL ORGANIZATIONS AND ASSOCIATIONS

Association Internationale Contre le Bruit
International Civil Aviation Organization
International Commission for Radiological Protection
International Federation of Air Line Pilots Assns.
World Meteorological Organization

OTHER ORGANIZATIONS

Aeronautical Radio Inc.
Aéroport de Paris
Air Line Pilots Association
Air Transport Association of America
Cornell Aeronautical Laboratory
Flight Safety Foundation
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McGill University
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Air Transport

Noise Tests for the 720

IN order to complete Ministry of Aviation noise (" quietness "?) tests, an Irish International Airlines Boeing 720 visited London Airport on Apr. 20. It was, we believe, the first time a 720 had been to London; subject to M.o.A. approval being obtained, Irish International plans to fly two services a day between London and Dublin from the end of July. This will usefully increase the utilization of the three 720s, which are otherwise engaged on the transatlantic service from Shannon, and will provide needed capacity in the peak summer month of August. The two-class cabin arrangement seats a total of 117 passengers.

To allow the necessary measurements to be made by ground observers, the Boeing 720 was flown off London's 28L runway in characteristic minimum-noise flight profiles, and then completed slow-and-low circuits in the airport vicinity. There seems to be no reason to expect the 720, with its slightly less powerful engines than the original 707-120, to be any more noisy than the Boeing variants already approved for operation at London Airport.

Flights made in the Irish Boeing during these trials were scarcely sufficient to assess its comfort or even to appreciate its decor, in tones of green. Since the fuselage is of the same cross-section as the larger Boeings, there is little to distinguish this variant so far as passenger appointments are concerned, although, for the more observant, the inner-wing glove is noticeable from the centre cabin windows.

The spaciousness of the 707/720 cabin still impresses, even after a dozen or so flights and more than 16,000 miles of Boeing travel—and it is a particularly salutary thought that, from the floor up, this same cross-section is to be retained in the smaller Boeing 727. This spaciousness seems likely to be at least as popular with travellers as the small time advantage which will be enjoyed by the 720s between London and Dublin, on which route B.E.A. does not intend to replace Viscounts with Vanguards until 1963.—F.G.S.

Convairs for Swissair

DELIVERIES of Convair 990 Coronados to American Airlines, Swissair and S.A.S. are expected to be up to six months late because of a programme of modifications found necessary after the preliminary flight trials (see our issue for Apr. 13, p. 408). Because of this delay, General Dynamics Corpn. has arranged to make two Convair 880-Ms temporarily available to Swissair. These aircraft will be delivered for use on the Swissair Far Eastern routes late this summer, at approximately the time originally scheduled for the Convair 990 services. They will have a 64-seat economy class cabin, plus 20 first-class seats and a 10-seat lounge.

The Convair 880-M is an advanced development of the original 880 with leading edge slats, greater fuel capacity and all-up weight and other improvements. The 990 Coronado has a larger fuselage, a further increase in fuel and gross weight, turbofan engines and higher cruising speed. Problems which have shown up in flight testing of the first two production Coronados are concerned with turbulent airflow at the junction of the inboard engine pylons and the wing leading edge; elevator effectiveness; and oscillation of the outboard engines.

Modifications will include addition of Kreuger-type flaps on the leading edge between the fuselage and inner pylons; a change in the elevator tab control linkages and a slot in the elevator to increase airflow over the tab at large angles of deflection; and shortening the outboard pylons.

K.L.M. to the West Coast

NEGOTIATIONS between the Netherlands Government and the U.S. State Department on approval for an Amsterdam-Los Angeles great circle route are to be resumed. This follows discussion between President Kennedy and the Dutch Foreign Minister earlier this month, and is at the direct invitation of the State Department. Previous negotiations broke down last year with the refusal of the U.S. to allow K.L.M. to serve the West Coast.

According to *Aviation Week*, talks are to be resumed at the direct instigation of President Kennedy, and K.L.M. will be granted the West Coast route subject to certain conditions restricting capacity. These conditions include an exchange of traffic statistics and agreement on the definition of " stop-overs " in relation to traffic carried by K.L.M. across the North Atlantic.

Hurrah for Gatwick

NOW that two round trips a day between London and Paris are being operated by B.E.A. from Gatwick (and two more by Air France) the advantages of that airport for the passenger have, it seems, been suddenly discovered. In marked contrast to former airline reluctance to use London's No. 2 airport is the praise for it in a full-page B.E.A. advertisement in last week's *Travel Trade Gazette*. Aimed at travel agents, this advertisement has the eye-catching slogan " Let Them Catch Their Plane by Train " and goes on as follows:

" Here is the neatest route from the heart of London to Paris . . . from Victoria Station, or any station on the Brighton line, take the train service right into London (Gatwick) Airport — Britain's newest and most modern airport — step aboard a Vickers Vanguard or Viscount . . . uncomplicated."

Perhaps necessity mothered some inventiveness on the part of B.E.A.'s copy writer. For our part, we have always regarded Gatwick as an entirely acceptable point of arrival or departure for London, and find it vastly more convenient to plan a journey to or from Victoria than the West London Air Terminal.

A STRANGER FOR DUBLIN.—On Apr. 15 a Sud-Aviation Caravelle was seen for the first time at Dublin's Collinstown Airport when Air France's " Lorraine " (F-BHRB), which is the aircraft used by President de Gaulle for his overseas visits, came over from Paris on a charter flight.

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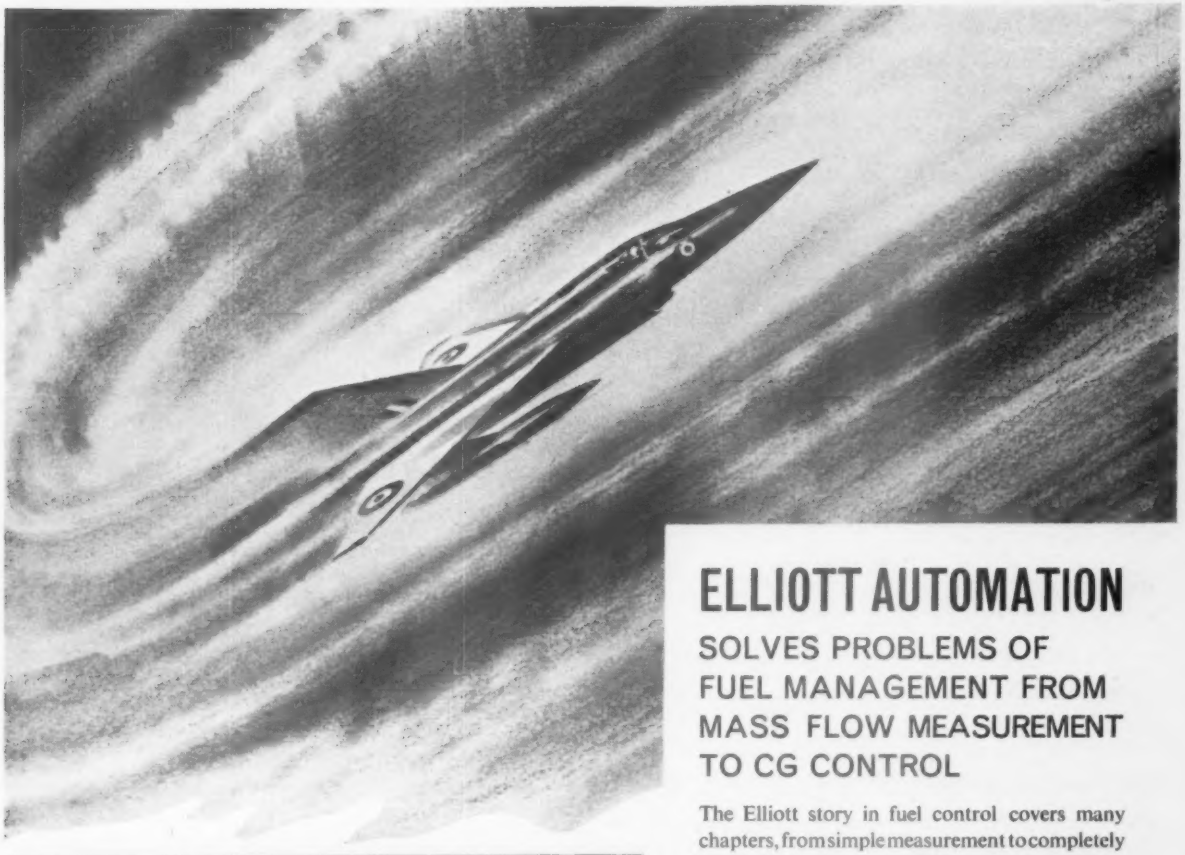

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RESEARCH

Observation of after burning in a gas turbine engine at a government research station. This is typical of the many research applications for which television is being used to-day.

Air Transport . . . .

Deferred-payment Flying Training

THE first group of prospective commercial pilots in a new training scheme will be undergoing their initial air checks next week. This scheme is operated by the Air Schools Organization—at Elstree, Herts, and Derby (Burnaston)—in conjunction with United Dominions Trust.

Selected ab initio aspirants will be trained up to Commercial Pilot's Licence and Instrument Rating standards during a period of approximately 9-10 months (including a minimum of 220 hr. flying) and will repay the cost from later working salaries over a period of 2-3 years. Pupils are required to attend the courses on a full-time residential basis and the total cost for an ab initio pupil will be about £1,900 (of which £1,385 is the normal maximum loan), including Private Pilot's Licence training (not included in the loan), M.o.A. examination and test fees, messing and accommodation, and ground training, for which an education authority grant may be obtainable.

A candidate does not need to have a firm offer of employment before joining the course, so obviously the selection procedure is a fairly stiff one. Initial "vetting" is by the U.D.T., which supplies the credit, and approved candidates then attend the Air Schools selection board, so that all concerned may be satisfied that the applicants are really determined and suitable to become professional pilots. Completion of the course is then subject to successful training up to P.P.L. standard. Alternatively, if the candidate already holds a P.P.L., he will, unless known to Air Schools, be required to complete 10 hr. of "grading" flying before final acceptance.

Basic flying on the course is completed on Chipmunks, with some cross-country time on Auster J1Ns, and twin conversions on an Apache.

The U.S. Airline Depression

AMERICAN carriers are in a depression, according to C. R. Smith, president of American Airlines. In a characteristically outspoken statement to shareholders, he said that they cannot hope to operate at a reasonable profit if the C.A.B. "continues to expand the air route system as in the past, creating competition that is not needed and cannot be supported by available traffic." If past trends continue the airlines will either return to Government subsidy or eventually go bankrupt.

The C.A.B. has said that trunk airlines should earn 10½% on their investment. The total investment of the domestic trunk lines is about $1,750,000,000. Yet the total industry earnings after interest in 1960 were only about $4,000,000. In no year since 1955 have the airlines earned the 10½% which the board found "the industry requires."

Mr. Smith said conditions today are similar to those of 1946-49, when earnings were less than 1% on investment. Both depressions have been affected by a high level of business activity, followed by a recession; enormous route expansion programmes, and large airline re-equipment programmes. He said the first depression was caused by the C.A.B. assuming a greater profit potential for the industry under peacetime conditions than actually developed. The board also decided the best way to aid "needy" airlines was to give them access to larger markets, often already served by other carriers.

The near-bankrupt industry did recover due to subsidies, a slowing down in route awards, fare increases and the post-Korean War traffic growth. The good earnings of the early 'fifties led to another round of route expansion. By 1958 there was competition on 348 of the 400 most important domestic routes. In three years the number of routes with three or more carriers increased from 38 to 115.

Nine trunk lines were authorized between New York and Washington, six between New York and Boston, five between Detroit and New York, and five between New York and Chicago.

Such duplication is increasingly dangerous as the airlines have acquired some of the fixed obligations of older utilities, like water and power. Unused airline capacity has steadily grown more costly. Just as there can be too little competition, there can also be too much.

Government subsidies are not the answer to the trunk line depression, Mr. Smith asserted. They discourage self-reliance and often reward inefficiency. Rather, the C.A.B. should keep the 10½% earnings standard more in mind, and make new route awards *only* when there is a proven public need. Airline mergers offer a promising opportunity today, as they did in 1946-49, but are not a panacea. Mergers of carriers lacking financial and other resources may temporarily conceal the basic problem, but make the final solution more painful.

Further fare increases may narrow the market and reduce the industry's rate of growth. More attention should be given to the suspension of uneconomical services, Mr. Smith concluded.—N.A.M.

Stereoscopic 3-D Radar

A RADAR presentation offering depth perception for its viewer has been developed by the Hughes Aircraft Co., and was demonstrated in public for the first time on Apr. 18. Using either a Hughes three-dimensional frequency scanning antenna or separate radar-scanner sources of range/bearing and altitude signals, the eventual display, known as "stereoscan," permits the viewer to distinguish altitude separation between target trails.

Two radar displays ("Tonotrons") are used, mounted at right angles to each other. One provides normal PPI information and the other shows the targets' altitudes. By means of a front-surface, half-silvered mirror arranged at 45° to the plane of the phosphor of each of the two tubes, the faces of both are made to appear, to the viewer, to coincide.

Polaroid filters, and special polarized spectacles worn by the viewer, cause the information from the two basic displays to be seen separately by each eye and depth perception is provided by the introduction of a degree of parallax in proportion to the altitude of the different targets. The past histories of targets are "stored" as bright tracks on the display, which can be viewed under normal room lighting conditions.

In use, the device shows a PPI map display above which the airborne targets are seen in appropriate relief. In the demonstration on Apr. 18 the region under surveillance was the Greater Los Angeles area—so there should have been an adequate number of echoes.

MIDLANDS TERMINAL.—This new passenger handling building at Birmingham Airport is to be opened tomorrow, Apr. 28, by H.R.H. the Duchess of Kent, who opened the original terminal at Elmdon on Jly. 8, 1939. The new building comprises administrative offices and Customs on the ground floor, and a lounge and restaurant on the first floor.

A.T.C. from All Aspects

Photograph copyright "The Aeroplane and Astronautics"

OPENING with a discussion of the problems and responsibilities of aircraft control from the point of view of the State, the civil airline, the military operator and the individual ground controller, last week's symposium on Air Traffic Control covered many aspects of this involved and important subject. Held in the R.Ae.S. lecture theatre in Hamilton Place, the all-day discussion included papers on the future of A.T.C. and the possible effects of the application of automatic and collision avoidance systems to the present control techniques.

Introduced by the chairman, AIR VICE-MARSHAL SIR LAURENCE SINCLAIR, Controller of Aviation Ground Services, M.o.A., the first speaker, GP. CAPT. J. B. VEAL, Director-General of Navigational Services, presented a paper on the responsibility of the State for A.T.C.

This set out the A.T.C. scene by describing the United Kingdom control service and the system of airways, control zones and other controlled airspaces operated by the three A.T.C. centres, including the recently introduced upper air routes above 25,000 ft. It also briefly covered the implementation of the national control policy through the National A.T.C. Board which is now working towards a joint military/civil system.

Turning attention towards immediate improvements in the U.K. service, Gp. Capt. Veal said that the provisional VOR/DME plan is for approximately 35 beacons. Of these, seven or eight VORs are now in commission and about another seven have been installed. The existing three A.T.C.C.s are to be replaced by two new centres, but in the meantime improvements are to be made to their operations rooms—including the introduction of closed-circuit TV and "ring strobing" on radar displays.

During the next three years new long-range civil radars will be coming into operation. Providing cover between 4,000-30,000 ft. the first will go into service with the Southern A.T.C.C. located at London (Heathrow) Airport later this year. Lateral aircraft separation under radar cover is five miles—compared with procedural control separation of about 40 miles.

The main U.K. control problem was stated to be that 80% of all civil traffic spends its time climbing or descending. To help improve this position new climb/descent paths are being introduced, together with some reorganization of the London Control Area.

Two other special problems are those associated with the North Atlantic at high level, and the English Channel at low level. The first involves the need to reduce the present aircraft separation requirements in co-operation with the United States; and the second is caused by the large increase—20% to 25% each year—in movements below 3,000 ft. New low-level Channel air routes are coming into service this summer and a study is now being made of these traffic flow patterns which involve up to 900 movements a day.

A Three-dimensional Problem

Presented by MR. A. FIELD, Master of the Guild of A.T.C. Officers, the second paper took the form of an examination of the abstract background of the profession of air traffic control. It included an attempt to categorize A.T.C. stress fatigue and to suggest circumstances attributable to these conditions.

The primary cause for control stress fatigue was put down to the nature of the work, combined with environmental considerations. Its effects have been found to include the deterioration of the controller's skill and timing; a growing anxiety complex regarding a certain problem; and, after a number of years' service, the inability to continue at a high pace of operation.

It was suggested that the answers can be found by the introduction of "black boxes" to permit the controller to have more "thinking time" for formulating his executive instructions. With the present A.T.C.C. equipment controllers still have to visualize a three-dimensional traffic situation from a two-dimensional display. During the next decade, Mr. Field thought, air traffic control might progress from an art to a science.

The civil operators' point of view was presented by MR. A. E. SLOCOMBE, Superintendent, Air Traffic Services, B.E.A., who based his paper on European operations only. The primary airline consideration is for protection from collision in every phase of flight and Mr. Slocombe thought this could be obtained without limiting the development of private and business aviation in this country.

He considered that the A.T.C. service does not meet present civil requirements, let alone its future needs, and that military/civil flying should be separated as far as possible. Supporting the "air-miss" reporting procedure, Mr. Slocombe said that the confliction of VFR and IFR traffic was the main cause of the air-miss situation and that full control was the answer. IATA airlines now file IFR flight plans in several areas of Europe.

Control and military operational requirements were presented by AIR CDRE. J. B. RUSSELL, Director of Operations Maritime, Navigation and Air Traffic Control. He described the various types of flying undertaken by the R.A.F. and then went on to cover the development of joint military/civil use of radar and the relaying of radar information to A.T.C.C.s (see THE AEROPLANE AND ASTRONAUTICS, Mar. 30, 1961).

During the discussion which followed the end of the morning's papers, the proposed installation of TVORs (terminal) at the Epsom and Watford reporting points, as opposed to long-range beacons, was criticized by two members of GAPAN. In reply it was stated that these two TVORs would have a range of 35 miles which was considered sufficient.

The very difficult siting problems of VOR ground stations were referred to by Gp. Capt. Veal in answer to a question on the piecemeal installation of the U.K. VOR network. Doppler-type VOR, described in our previous issue, has been considered by the M.o.A. as a method of overcoming siting problems in this country.

The first point made by MR. E. W. PIKE, manager, Air Traffic Management Division, General Precision Systems, was that though easy enough to make a list of necessary improvements to the A.T.C. system, it was difficult to choose the order in which these should be applied, so that effort would not be wasted. The present system works and no sudden fundamental change could be considered.

In a discussion of the application of automatic techniques to A.T.C. problems, Mr. Pike said that the aim should be towards evolutionary changes which provided assistance for the controller (the cheapest computer on the market) and which involved the minimum foreseeable equipment redundancy in the future. Action was needed now and electronics engineers must obtain complete and practical knowledge of the really

important factors and problems. Mr. Pike showed a table (reproduced here) giving the order in which progressive changes might be made to meet growing requirements.

Two groups of specialist professionals—controllers and aircrew—were concerned in the operation of the total system. Improvements in airborne and ground equipment were equally important and the A.T.C. problems should not be simplified at the expense of those on the flight deck. Earlier in his talk Mr. Pike had suggested that, if a serious effort were to be made, the smaller executive/private aircraft could be equipped so as to be accommodated in the overall A.T.C. system.

Type of system	Data transfer	Display preparation	Display updating	Conflict detection	Conflict resolution	Air/ground communication
(a) Fully manual	voice	manual	manual	controller	controller	voice, etc.
(b) Partly mechanized	teleprinter, etc.	manual	manual	controller	controller	voice, etc.
(c) Machine-assisted flight-plan processing	teleprinter, etc.	strip printer	manual	controller	controller	voice, etc.
(d) Semi-automatic	teleprinter, etc.	strip printer	automatic flight progress board	controller	controller	voice, etc.
(e) Semi-automatic with conflict detection	teleprinter, etc.	strip printer	automatic flight progress board	computer	controller	voice, etc.
(f) Fully automatic	teleprinter, etc.	strip printer	automatic flight progress board	computer	computer	data link

This table (Mr. Pike's paper) shows the time-scale in which automatic techniques may rationally be applied to meet A.T.C. requirements.

As for the capacity of the electronics industry, Mr. Pike pointed out that both the existing systems leading towards automation in A.T.C. had been conceived and developed by private enterprise.

Describing some F.A.A. experiences, MR. J. L. ANAST, director of the Agency's Bureau of Research and Development, ran over some of the problems and solutions in the programme. He made the important point that controlling was, like flying, a "pretty artistic business." Nobody could work out all the intricacies of a good landing, but automation was coming in now to help the pilot even in this complicated phase of his work; in the same way automation would eventually add to the performance of the controller.

The new data processing equipment for the F.A.A. had been under test for a year and the first system checks would start in July. Mr. Anast said that the problems of automatic data processing had been underestimated, but that a lot had been learnt from the experiments with general-purpose computers. The flight-progress strip, written or printed, would never be replaced by electronic or other devices unless these could be absolutely reliable; the strip provided a tangible record and there was nothing better yet. Mr. Anast, who had arrived that morning from the U.S.A. and was leaving for Paris the same evening, took a particularly lively part in the two discussion sessions.

The development of primary and secondary radar was described by MR. G. G. ROBERTS, technical director, Cossor Radar and Electronics, in an introduction to the problems and use of transponders in A.T.C. and to a description of equipment. He discussed the methods of arranging the interrogation scanner in relation to the primary radar scanner, described the side-lobe suppression situation (see our issue of Feb. 3, p. 114) and illustrated an altimeter pick-off system under test.

CAPT. V. A. M. HUNT, Director of Control and Navigation Development and Planning, M.o.A., discussed the progress of civil/military A.T.C. co-ordination in the U.K. and in Europe under Eurocontrol, before outlining some of the present and planned developments and the work being done by the A.T.C. Experimental Unit. He dealt briefly with terminal area problems and the possible use of parallel runways; with the North Atlantic situation and the reduction of separations; and with low-level control difficulties in the Channel area—where the present *ad hoc* scheme would need to be reconsidered and a more sophisticated system introduced.

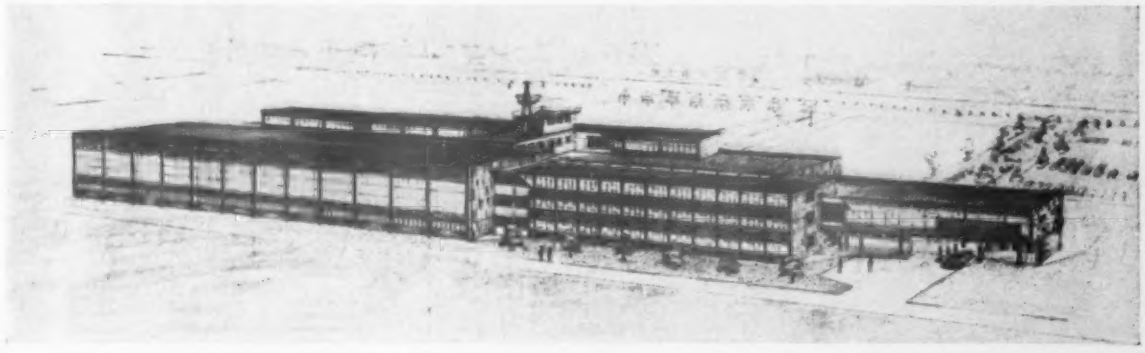
Finally, he discussed some of the factors in the control of supersonic transports. Even if normal subsonic characteristics are to be assumed for take-off and at lower levels, the SST may, it seems, pose some new and special problems. Once clear of the initial low-level pattern and before transition, the SST will probably climb at about 500 kt. and 8,000 ft./min. up to 40,000 ft. plus. There, it will need to have airspace freedom while passing through the difficult transonic régime before climbing, at, say, M=1.7, to its initial cruising altitude of 55,000 ft. plus. Freedom during the transition to subsonic speed will also be needed on the descent.

In the course of his talk Capt. Hunt demonstrated a typical minor problem in the relative ineffectiveness of progress strips when produced by normal teleprint methods. Of radar developments, he thought that a 3-D system would be useful (for instance, as a means of cleaning up height levels), but that telemetered altimeter readings were likely always to give more accurate height information. Data link systems would only show their full value when the information could be fed directly into a computer and there were international coding problems still to be settled.

Discussing collision-avoidance-system prospects under a title designed by the R.Ae.S. to be deliberately provocative ("Why Air Traffic Control?"), MR. R. F. HANSFORD, of Decca Radar, showed that the problems involved in the development of such systems were very considerable and that, even if these were solved, the use of the systems was not likely to affect A.T.C. requirements. Even if universally applied, collision-avoidance systems would be practicable only in en route, light-traffic-density conditions; in terminal areas, if only because of the cumulative effects of avoidance manœuvres, A.T.C. would need to provide the anti-collision guidance.

The likely influence of the characteristics of future aircraft on A.T.C. were discussed in the two final talks. MR. B. N. TOMLINSON, of R.A.E., Farnborough, outlined some of the likely features of supersonic aircraft in terms of turning radii and operational sensitivity, and MR. J. K. B. ILLINGWORTH, of R.A.E., Bedford, discussed the flight paths of VTOL aircraft and helicopters in relation to those of STOL and normal aircraft.

The two discussions in the afternoon, though relatively brief, covered a wide field—from the deficiency (or otherwise) of the progress board as a means of providing essential information, to the question of whether there might be a need for some fundamental re-thinking on the basic philosophy of A.T.C. The answers were occasionally on "we-just-don't-know-yet" lines, but were mostly based on practical experience. It was explained, for instance, that the progress board makes sense to the controller and that control by accurate pre-planning was "a big trap"—30 minutes is just about as far ahead as the effects of pre-planning can be assumed to be maintained in normal operating conditions.



An architect's impression (Capt. Hunt's paper) of the proposed new Southern Air Traffic Control Centre building at Heathrow. The administrative block is on the right and the technical block is on the left.

British Executive Operators

5 Shell Aircraft, Ltd.

MORE often than not, executive aircraft are used to provide transport facilities to places which would not otherwise be easily accessible. In the case of the Royal Dutch/Shell Group of companies, whose integrated headquarters are split almost equally between London and The Hague, and are linked by excellent scheduled services, a requirement has still been found to exist for an executive fleet for the benefit of top-level management.

This is not a question of prestige; the Shell aircraft are soberly and discreetly painted in the company colours, and are kept very much in the background. The London fleet operates primarily for the convenience of the seven managing directors in the Group, plus a few of the principal executives, amounting to about 20 people in all, whose time is worth at least as much as it costs to operate the four aircraft maintained for their use. When it is considered that some of the executives may make as many as three trips per week between London and Holland, the time saved through the use of business aircraft becomes apparent.

Apart from avoiding the laborious formalities inevitably associated with airline travel, executive aircraft have the invaluable facility of being able to conform instantly with unexpected changes in programme, thereby freeing management representatives to a large extent from the tyranny of time. The Shell aircraft are also kept available for use at very short notice, with a crew on stand-by at home, if not at the airport, at all times, for take-off within a couple of hours of a request.

Shell executive operations began in 1950 with one D.H. Dove and one pilot, based at Croydon, and maintenance contracted out to Morton Air Services. The London-Hague service was the main requirement, although the Shell organization has offices in nearly every major city throughout the World, and the U.K.-based aircraft sometimes fly to Brussels, Paris, Zürich, Geneva and so on, as well as farther afield.

By 1954, a four-engined Heron had been added to the Dove, to expand operations, and two more Herons were acquired in 1956, with the Dove placed in reserve. The Heron fleet proved entirely satisfactory until 1959, when the need for pressurized aircraft was expressed by some of the executives. At that time, no suitable pressurized executive type was available, but as B.E.A. was disposing of its Ambassador fleet, the opportunity was taken of obtaining two of these well-proven and comfortable aircraft at a relatively low first-cost.

Although larger than the optimum size for executive use, the Ambassadors had many advantages. In business flying operations, where utilizations are very much lower than with airline equipment, low first-cost is perhaps more important than direct operating costs in achieving reasonable overall expenses. The large payload capacity and spacious fuselage of the Ambassador enabled a 10-seat conversion to be done economically without the normal expensive emphasis on weight saving. It is also possible to carry full fuel loads with the normal passenger complement so that although five out of six flights are between London and The Hague, and 96% of all trips are over stage lengths of only 210/230 st. miles, diversions of considerable length are possible.

Managing Director of Shell Aircraft, Ltd., is Gp. Capt. Douglas Bader (right), who is seen here with Capt. G. Rees, chief pilot of the London fleet.

The Ambassadors, G-AMAG and 'MAA, are able to take an exploratory look-see in marginal conditions, with no diversion problems, and with the comprehensive radio and navigational aids installed, regularity of operation in all weather conditions has been remarkable. This of course is also due to the high standards of the Shell flying personnel who, under the chief pilot, Capt. G. Rees, comprise four other captains and four first officers with the appropriate professional licences.

The Shell London fleet, in fact, operates virtually as a self-contained airline, having two engineer officers and two hostesses, plus traffic and movement officers of its own, supplied by Field Aircraft Services, Ltd. This company has the contract for maintenance of the Shell fleet at London Airport, and assigns full-time staff and hangar space to its operations under the Shell Resident Engineer, Mr. W. J. Williams.

Field's were responsible for the conversion of the Ambassadors, which necessitated the complete re-arrangement and refurnishing of the interiors, and the modernization of all radio and navigational aids. As distributors for Bendix equipment in the U.K., Field's installed that company's RA 21 ILS/VOR, GSA8A glide-path receiver, and MKA7A1 marker receiver, and also added a Mk. 10 Decca Navigator with Flight Log (Decca is standard in all Shell aircraft) an STR 9Z VHF set for military frequencies, and an Ultra UA 17 intercomm.

The original duplicated STR 12D VHF, Marconi AD 7092 ADF, the Marconi AD 107/94 HF and the STR 14/15 ILS were retained. But the original two small batteries were replaced by four 80-amp./hr.-type units to cope with the very comprehensive electronic equipment and to provide ample power for starting where ground facilities might not be available.

To convert the 49-passenger interior to an executive layout for 10 persons, with facilities for complete relaxation and for work, the fuselage is divided basically into two cabins, with an additional cabin providing sleeping accommodation for two if required. The two divans are located in the centre cabin, behind which is accommodation for four senior executives in

Photographs copyright "The Aeroplane and Astronautics"

The rear cabin of the Shell Ambassador is luxuriously furnished for four executives accommodated in these swivelling, reclining and sliding Burns seats.

Photograph copyright "The Aeroplane and Astronautics"

Quietly resplendent in their Epikote paint, an Ambassador and a Heron 2D of the Shell London fleet are seen at their London Airport base.

fully swivelling, sliding and reclining seats, a toilet and a spacious dressing-room.

Forward of the main spar is a cabin providing a further six seats with "sleeperettes" and a toilet-cum-dressing-room. Between the flight-deck and the forward cabin are the freight hold and the galley.

After their overhaul and conversion, the two Ambassadors were finished in an overall grey Shell Epikote-base paint on a trial basis. This epoxy-resin finish is very tough and resistant to wear and tear, and was subsequently applied to the Herons as they became due for overhaul. Experience has shown this paint, the base for which was developed by Shell's chemical experts, to be extremely durable. Worth-while savings in aircraft cleaning times have become evident and there is a great improvement in appearance.

By restricting the gross weight of the Ambassador to 50,000 lb. instead of the 55,000 lb. limit in B.E.A. service, it was possible to reduce the pressures of the main undercarriage oleos and tyres, with a corresponding improvement in comfort during taxi-ing and take-off. Comfort is perhaps the keynote of the Ambassador conversion, but it cannot be overdone, since the Shell executives usually carry on working in the aircraft, and require all possible facilities. Oddly enough, a heating system which was adequate for nearly 50 people is not enough for 10, or the usual smaller load; and a portable electric blower is therefore provided which can raise the interior temperature to 85° F. in 20 minutes.

Airport Problems

With the acquisition of the Ambassadors came the closing-down of Croydon. Following an assurance from M.o.A. that Blackbushe was to remain open, the Shell London fleet therefore moved out to that airport in early 1960. Within a week or two, however, Blackbushe in turn was closed by the Ministry; and, with other operators, Shell were advised to go to Gatwick. Since no hangarage is available there permission was eventually obtained to operate from London Airport, but this has been conditional on giving 24 hr. advance notice of all flights.

As one of the main advantages of executive flying is its flexibility, the necessity to book in advance and obtain a take-off time which is dependent on the amount of traffic anticipated, is obviously undesirable. The allocation to private aircraft of hardstandings which are unpopular with the airlines causes less difficulty, since surface transport is naturally simpler to arrange, and it is sometimes possible to arrange a trip at short notice.

Towards the end of 1960, one Heron and the Dove were sold, to maintain a fleet of four units. The three Herons had flown a total of 1,135 hr. during 1958, 1,190 hr. in 1959, and 1,059 hr. in 1960, when one was withdrawn in September. The Dove had flown 134 hr. (1958), 253 hr. (1959) and 121 hr. before its withdrawal in 1960, and the Ambassadors have since completed 500 hr. each per year. The Herons, G-ANUO and 'OHB, have been maintaining their 400 hr. per year each.

The four-engined aircraft are comfortably furnished for six passengers, and carry a crew of two. Their maximum fuel tankage is 416 Imp. gal. and their normal consumption is 44 gal./hr., giving a max. endurance of more than nine hours, at cruising speeds around 155 knots. As only about 3% of the Shell flights are over stages of 450/650 st. miles, cruising speeds are not considered particularly important. The chock-to-chock times, for example, of the Herons from L.A.P. to Amsterdam are only a few minutes longer than those of the commercial Viscount services.

The Heron 2Ds are equipped with Decca Mk. 8, Marconi AD 107/AD 94 HF, STR 12D VHF, STR 9Z VHF, Marconi AD 7092D ADF and STR 14B/SR 15B ILS equipment. Their Gipsy Queen 30 engines are cleared for 1,600 hr. between overhauls.

In executive service, the Ambassadors normally carry their full load of 1,000 gal. of fuel, and use about 175 gal./hr. for a cruising speed of some 200 knots, at the usual short-range operating heights of 13,000 ft. The Shell aircraft always fly airways, the Ambassadors carrying a crew of two pilots, an engineer (who looks after pressurization in flight, but is carried mainly to service the aircraft away from base) and a hostess. The Centaurus 661s of the Ambassador are cleared for 1,250 hr. between overhauls.

It will be seen that the Shell unit is extremely well equipped to meet the policy of providing as near a 100% guaranteed service as possible. Delays through weather are extremely rare: unserviceability snags are virtually unknown. The number of aircraft in the fleet is governed by the requirements of peak load times during the month, all four aircraft being sometimes required for board meetings, etc. On some occasions, spare seats in the aircraft are occupied by other Shell employees, but policy is to avoid transporting the whole of any one section of the company in a single aircraft.

Internal U.K. flights are rare, usually being in the nature of "feeder" trips, to collect passengers for international transport. Flights are very occasionally made farther afield than Europe, particularly to the Middle East, in connection with

ACHIEVED OPERATING COSTS, D.H. HERON 2D

ANNUAL UTILIZATION	500 hr.	600 hr.	750 hr.	900 hr.	1,000 hr.
FIXED ANNUAL COSTS	Cost per flying hour (£)				
Depreciation: Aircraft and spares depreciated over 5 years with no residual value	20.0	16.7	13.3	11.1	10.0
Insurance: Annual premium 5% of assessed value	5.0	4.2	3.3	2.8	2.5
Hangarage: Proportion of total hangar costs at London Airport	5.6	4.7	3.7	3.1	2.8
Crew: Salary and expenses, captain and first officer	12.6	10.5	8.4	7.0	6.3
HOURLY COSTS					
Maintenance and General:					
Airframe	10.0	8.3	7.5	5.5	5.0
Engines, using D.H. exchange scheme and an overhaul life of 1,600 hr.	2.5	2.5	2.5	2.5	2.5
Propellers, D.H. exchange scheme	1.1	1.1	1.1	1.1	1.1
Fuel and Oil:					
Fuel consumption of 44 Imp. gal./hr., less averaged duty rebate for overseas operation, and oil as proportion of total	6.8	6.8	6.8	6.8	6.8
Landing Charges:	2.4	2.4	2.4	2.4	2.4
Total operating cost per aircraft flying hour	66.0	57.2	49.0	42.3	39.4
Cost per aircraft mile—shillings	8.8	7.0	6.5	5.6	5.2
Cost per seat mile (6 seats)—pence	17.3	14.0	13.0	11.0	10.3

96% of the Shell London fleet operations are over stage lengths of 210/230 st. miles.

exploration and production matters. The Shell London fleet has sent its aircraft to such places as Tunis, Cairo, Algiers and Libya, and its Herons have been into rough desert strips to oil search sites—but these rare trips are outside its main preoccupation of executive commuting.

They also tend to overlap with the wider function of Shell Aircraft, Ltd., which was formed to advise on the use of aircraft in all aspects of Royal Dutch/Shell Group operations. Headed by Gp. Capt. Douglas Bader, Shell Aircraft, Ltd., includes many other fleets in addition to the London unit, all self-contained under their own chief pilots or managers. These, of course, are not executive fleets, being concerned mainly with production and exploration, and operate about 80 aircraft in various remote parts of the World, such as Borneo, Indonesia, Nigeria and the Argentine, plus a similar number in North America.

About half the total are on full-time charter, and include a number of helicopters, which are particularly suitable for undeveloped countries with few airstrips. Rotorcraft would also suit the Shell Group's London-Hague operations, depending on the development of city-centre to city-centre operations, with suitable Customs heliports, and the appearance of a reasonably economical twin-engine helicopter. The Group would not approve the use of a single-engine type, either helicopter or fixed-wing, for transport of its executives.

So far as the London fleet is concerned, the problem of re-equipment will present itself—perhaps within two or three years—and the position is easier in so far as a wide range of specialized executive aircraft is now available. As most of these are foreign, however, involving the payment of a substantial amount of duty on their import, and first costs have been shown to be very important to low utilization operation, products of the British industry would naturally be preferred.

The Shell Group depreciates its aircraft over a five-year period, since the older types may well be out of date after that time. With some of the very expensive executive types, it is possible for annual depreciation alone to amount to more than the total running costs of current business aircraft such as the Heron.

Speed is relatively unimportant to Shell operations, which are also 99% short-range, but the recently announced D.H. 125 twin-jet six-seat executive project, among others, would obviously suit most of the Group's requirements, including the promise of a relatively low initial cost and operating expenses little greater than those of its piston-engine predecessors.

JOHN FRICKER.

Search and Rescue in Canada

THE current introduction of a new aircraft, the Grumman CSR-110 Albatross, provided a recent opportunity to visit and study the R.C.A.F.'s search and rescue organization. Like the flying doctor organization in Australia, this has achieved notable fame through its mercy flights. Its operations cover Canada's 3,620,000 sq. miles and an important part of the R.C.A.F.'s resources are devoted to it full-time.

Actual administration of the search and rescue function is carried out by local command headquarters. For example, rescue activities in Eastern Canada and the rescue co-ordination centre at Trenton (Ont.) fall under the jurisdiction of Air Transport Command (Air Cdre. F. S. Carpenter, A.F.C.). The Command is also responsible for arctic reconnaissance, aerial photography, survival and rescue training; the auxiliary squadrons, air cadets, joint forces air training, operations and doctrine and, of course, air transport.

Prior to World War II, search and rescue was non-existent, at least on an organized basis, in Canada. Following the 1944 PICAO convention in Chicago, the job was given to the R.C.A.F. as its existing facilities could form the nucleus of an organization. This move was not popular in British Columbia, whose unforgiving terrain causes many emergencies. Residents wanted a coastguard along American lines, and complained that emergencies too often required pleading for a helicopter from the generous Americans.

There are now four rescue co-ordination centres across Canada. Personnel are supplied by the air services branch, which also staffs flying control and GCA.

Each rescue co-ordination centre provides assistance to aircraft or marine craft in distress, investigates alerts, and takes search and rescue action if necessary. An aircraft or vessel is considered overdue if it is 30 min. past its ETA or five minutes after it has been cleared to land. Ninety per cent. of alerts end during a communications check, according to Flt. Lt. J. H. Helgason, O.C. of Trenton's Rescue Co-ordination Centre.

Civilian pilots, particularly those flying from the United States to Alaska via the North-west Staging Route, used to be a major problem, as they set out without proper flight planning or survival equipment. After many expensive searches, the R.C.A.F. took a stern view, and did some regulating, educating and cajoling. This has paid off, and there is now a general trend toward civilian pilots getting lost less often, and, when they do, using proper procedures.

At Trenton the actual flying is done by No. 102 (Composite) Unit, which is equipped with three Albatrosses, three Dakotas, four de Havilland Otters (some amphibious), three Vertol 44 and S.58 helicopters and a 40-ft. power boat. Aircraft from other units can be recruited if necessary. The unit is on 24-hour standby, seven days a week. One crew is at ½-hour notice during normal working hours and one-hour notice at other times, although it is a point of pride to be able to be off sooner.

A ground search party and 12 trained pararescue men are included in the "K.U.," and a jump master, two safety-equipment jumpers and emergency drop equipment are included in the standby crew. Kits for setting up operations rooms at advanced bases have been devised.

The standby aircraft is often a Dakota with internal long-range tanks. These tanks carry a usable 275 Imp. gal., giving a 12.5-hour endurance without reserves. ARA-8 VHF homers

Ten Grumman CSR-110 Albatross amphibians are replacing the veteran Canadian-built PBY-5A Cansos in the R.C.A.F. search and rescue organization.

are carried, while monstrous skis and JATO are also available. The skis make an enormous dint in the payload and are seldom used. The Dakotas normally fly at 28,000 lb., but during searches permission can be obtained for substantially higher all-up weights. A replacement aircraft is not yet in sight.

An aid to searchers is the URC-4 battery-operated VHF/UHF transmitter, which can be carried in a jet vest pack. SARAH is widely used by the R.C.A.F. and is recommended for civilian aircraft operating in sparsely populated areas. From 10,000 ft. one can pick them up at 50 miles. Their main shortcoming is the cost of replacing the batteries.

The Albatrosses are welcome replacements for the tired Canadian-built Cansos (PBY-5A Catalina amphibians, in other countries). The Grummans differ in detail from the American SA-16Bs, having 100 h.p. more per engine and other modifications. They can be equipped with skis on wing-tip floats and hull. TACAN, DME and Doppler are to be fitted.

Lancaster 10s are still in service for long-range search and rescue. Spares are a problem, however, and escorting an airline DC-7 with one engine out requires more than a nose-down attitude and determination. The Lancs are being replaced or supplemented by specially modified Canadair North Stars, which are being released from Air Transport Command by the arrival of Canadair's CL-44s (alias the CC-106). These R.C.A.F. functional designations, an ill-advised attempt to copy the Americans, have caused such confusion that, in the case of the Argus (also the CP-107 and Canadair's CL-28), at least, they are being dropped in favour of the name.

A single rescue centre may handle over 300 alerts a year, ranging from rescuing Eskimos who have been blown offshore on an ice floe, to picking up seven people whose Expediter has run out of fuel in the north. Although the "mercy flights" are publicized, much of the work, sometimes under difficult or dangerous conditions, goes unnoticed. The R.C.A.F. has also been hampered by outdated or unsuitable aircraft, but it is significant that the plea for a coastguard is now seldom heard.—N. A. MACDOUGALL.

The Fighting Services

Bomber Command Standards

IN addition to the presentation of a Standard to No. 101 Squadron (Wg. Cdr. W. J. H. Roberts), announced in our previous issue, two other V-bomber squadrons—Nos. 15 and 18—are also to be similarly honoured in the near future. H.R.H. Princess Margaret will present the Standard to No. 18 Squadron (Wg. Cdr. D. H. Sutton) at a double ceremony with No. 101 Squadron at R.A.F. Finningley on Jne. 6 and No. 15 Squadron (Wg. Cdr. J. G. Matthews, A.F.C.) is to receive its Standard from the Duchess of Kent at R.A.F. Cottesmore on May 3.

No. 15 Squadron was re-formed at Cottesmore as the second Bomber Command Victor B.1 squadron in 1958. Originally formed at Farnborough in 1915 it flew reconnaissance and bombing operations over the Somme in 1916 and harassed the German retreat to the Hindenburg Line in 1917. During the Second World War it first operated Fairey Battles, but subsequently flew Blenheims, Wellingtons, Stirlings and Lancasters.

Based at Finningley, No. 18 Squadron was formed at Northolt in 1915 and operated in France. It became one of the first squadrons to use successfully w/T communications directly between an aircraft and an Army H.Q. In 1917-18 it was employed on heavy bombing with D.H.4s and D.H.9s and was disbanded in 1919. Re-formed in 1931, the Squadron went to France in 1939 equipped with Blenheims. It started operating in North Africa in 1942 and subsequently flew in support of the landings on Italy, Sicily and Southern France. Between 1946-50 it was re-formed and disbanded several times. It was re-formed at Scampton in 1953, with Canberras, disbanded in 1957, and re-formed in 1958 with Valiants.

Middle East Aerobatics

LEADERSHIP of the Middle East Command (Aden) aerobatic team has been taken over by Sqn. Ldr. M. S. Goodfellow who has succeeded Sqn. Ldr. Ramirez as C.O. of No. 208 Squadron. Operating Hunter FGA.9s the Squadron is based at R.A.F. Eastleigh, Nairobi.

The four-aircraft team has taken part in 16 events since it was formed a year ago, including the celebrations marking the 81st birthday of the late Sultan of Zanzibar and the visits to R.A.F. Eastleigh of the Crown Prince of Ethiopia; the Governor of Kenya, Sir Patrick Renison; and Admiral of the Fleet Earl Mountbatten, Chief of the Defence Staff. It has also performed at East Africa's Malindi Festival and at the R.A.F. Khormaksar (Aden) "Open Day."

Bank Holiday Entertainment

NORTH WEALD comes to life again for a few hours on May 22 when the South-eastern area of the Royal Air Forces Association holds its second successive air display there. The Midlands and North too will get its share of Whit-Monday aviation. As last year, the Eastern area of R.A.F.A. is running a show at Hucknall and the S.S.A.F.A. is organizing one at Yeadon.

The first public appearance in this country of Fighter Command's new aerobatic team, No. 92 Squadron, will be the big draw at all three displays. No doubt some very critical eyes will be focused on the royal blue Hunters to see just how worthy a successor they are to the now legendary Treble One. Some details of 92 Sqn. were on page 432 of last week's issue.

Aerobatics by the 1959 Lockheed Trophy winner, Francis Liardon, flying a Jugmeister opens the show at Yeadon and after a visit to Hucknall he will provide the finale at North Weald. Both R.A.F.A. shows will receive visits from the C.F.S. Jet Provost team, a Gladiator, and a Hurricane and Spitfire are bound to awaken nostalgic memories of the Battle of Britain. S.S.A.F.A. can boast of a demonstration by the Avro 748 for its Yorkshire visitors.

All the displays will be visited by the usual R.A.F./U.S.A.F. Circus of Shackleton, Canberra, Britannia, V-bomber, Hercules, KB-50J, Super Sabres, Voodoos and Destroyers, and at each a number of personal and executive aircraft will be put through their paces.

R.A.F. Appointments

THE following are among recent Royal Air Force appointments:—

Air Ministry: Wg. Cdr. R. I. Alexander, D.F.C., Wg. Cdr. W. Edwards, Wg. Cdr. G. Steele, O.B.E., Sqn. Ldr. N. Allatson, and Sqn. Ldr. A. G. West (with acting rank of Wg. Cdr.) to the Department of the Air Member for Supply and Organization.

Bomber Command: Gp. Capt. P. H. Roscoe to Headquarters as Command Accountant; Sqn. Ldr. A. C. Richards, D.F.C., to R.A.F. North Luffenham to command the Administrative Wing, with acting rank of Wg. Cdr.

Fighter Command: Wg. Cdr. B. E. Peck, D.F.C., to R.A.F. Horsham St. Faith to command.

Coastal Command: Wg. Cdr. R. G. Price, D.F.C., to R.A.F. St. Mawgan to command the Administrative Wing.

Transport Command: Gp. Capt. S. P. Hagger, C.B.E., to Headquarters No. 38 Group, as Senior Officer, Administration; Wg. Cdr. L. L. Flowerdew to Headquarters, No. 38 Group, as Senior Technical Staff Officer; Sqn. Ldr. J. B. Mahoney to Headquarters, No. 38 Group, for operations duties, with the acting rank of Wg. Cdr.

Maintenance Command: Wg. Cdr. A. C. Morris, O.B.E., to No. 35 Maintenance Unit as Chief Equipment Officer.

Near East Air Force (Cyprus): Wg. Cdr. L. G. Holmes, O.B.E., D.F.C., A.F.C., to No. 70 Squadron to command; Sqn. Ldr. J. Tocher to Headquarters as Command Radio Officer, with acting rank of Wg. Cdr.

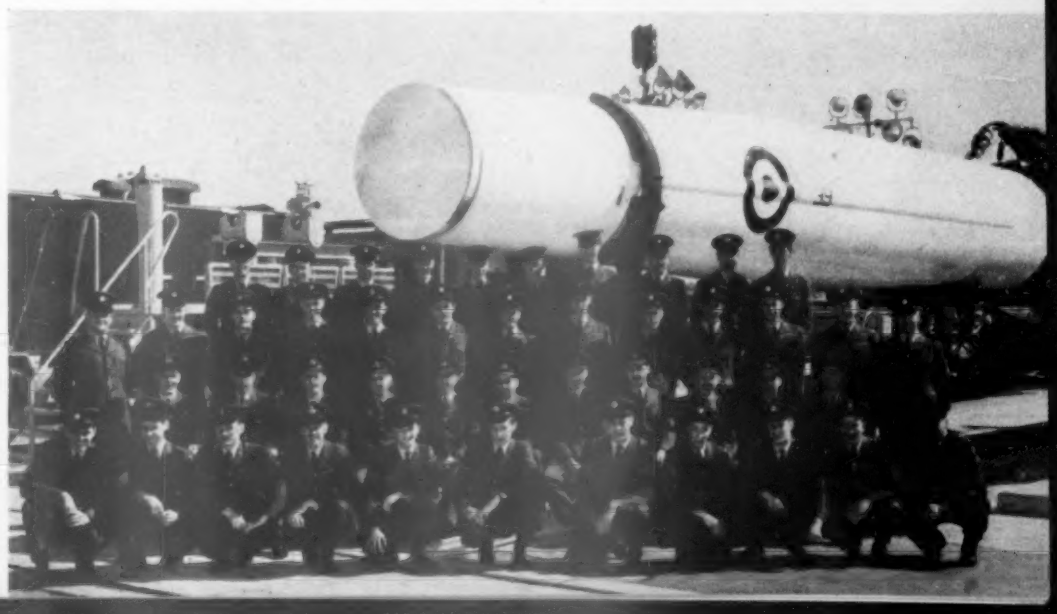
Far East Air Force: Wg. Cdr. J. W. Hume to Headquarters, No. 224 Group, as Senior Technical Staff Officer; Wg. Cdr. J. McD. Jannaway, O.B.E., to No. 389 Maintenance Unit to command; Wg. Cdr. P. Smith, M.B.E., to No. 60 Squadron to command.

Other Appointments: Gp. Capt. R. J. Abrahams, O.B.E., to Rome as Air Attaché; Wg. Cdr. G. V. Cowmeadow to U.S.A.F. on exchange posting; Wg. Cdr. A. B. Goldie to R.A.F. Fairford for liaison duties with the U.S.A.F.

More Service News

Rescue Demonstration.—A search and rescue team led by Sqn. Ldr. R. Jarvis, Command Navigation Officer, H.Q., Middle East Command (Aden), demonstrated rescue techniques and equipment to members of the Somali Air Wing in Mogadishu earlier this month. A Shackleton of No. 37 Squadron from R.A.F. Khormaksar also took part in the demonstration which ended with a reception of the team by Gen. Daud, G.O.C., Somali Land Forces.

SEATO Exercise.—Naval units which took part in the recent SEATO exercise "Pony Express" in the South China Sea included the carriers H.M.S. "Victorious" and H.M.A.S. "Melbourne," and the Commando carrier H.M.S. "Bulwark."



NIGHT LAUNCH.—Commanded by Sqn. Ldr. D. H. Downes, this detachment from R.A.F. Driffield recently fired the Thor IRBM in the background from Vandenburg A.F.B. It was the first night launch by a crew under the Bomber Command combat training programme.

Progress with Dyna-Soar

by Kenneth Gatland

IN the light of Russia's triumph in orbiting the World's first astronaut, America's man-in-space programmes are certain to be pursued with renewed vigour. The initial project to orbit a man in a one-ton Mercury capsule will be continued with the anticipation of getting the first American astronaut into orbit, using a modified Atlas-D ICBM, before the end of the year.

A short-range, sub-orbital, flight using the smaller Redstone booster is scheduled for late May or early June from Cape Canaveral. The manned capsule is expected to ascend about 100 miles before descending into the Atlantic by parachute some 300 miles downrange. Out of Mercury is expected to grow the much more ambitious Apollo programme with its twin aims of launching a 20,000-lb. manned space-station into an Earth-orbit, and of sending a similar vehicle on a flight around the Moon and back to Earth. This latter stage NASA hopes to achieve before the end of the present decade.

But Mercury is little more than an inhabited ballistic nose-cone—highly sophisticated it is true, and brilliantly engineered on the basis of medium weight, but nevertheless a re-entry vehicle in which the occupant is largely a passenger, destined to land at a pre-selected recovery area. The U.S.A.F.'s Dyna-Soar project, on the other hand, is an attempt to apply aircraft techniques to the problem of orbital re-entry, giving the astronaut as much freedom as possible to control his mission and land at a conventional airfield.

This has the greatest significance and would seem to be America's best opportunity to achieve some kind of parity with the Russians before 1965. A major article describing the Dyna-Soar programme appeared in our issue of Jan. 6, 1961 (Ref. 1).

In passing, it may be appropriate to recall the importance which the United States has attached to rocket flight in manned aircraft since the Bell X-1 first penetrated the "sound barrier" in 1947. Their latest achievement in this direction with the North American X-15—the research aircraft which has touched 2,905 m.p.h. and reached an altitude of 169,600 ft.—has not received the publicity it deserves, but this is one clear example of the way in which techniques are being developed in the United States to give the astronaut a greater measure of control over his destiny.

Dyna-Soar: separation of Titan's first stage.

The Orbital Glider

Studies which the Boeing Airplane Company have made in the past 12 months have considerably increased the U.S.A.F.'s confidence in the Dyna-Soar programme. Wind-tunnel research has confirmed that techniques which Boeing offered, in the early part of the programme, for the solution of heating problems associated with hypersonic flight were sound, although their final resolution will, of course, depend on the outcome of actual flight experiments, first with models and later with full-scale vehicles.

The wind-tunnel programme conducted for Dyna-Soar has been described as the most exhaustive in the history of flight. In fact, it is likely to treble the total time spent on similar data-gathering exercises for the X-15.

Every conceivable combination of the glider and its booster must be tested at various speeds, with the glider on top of the complete launcher, the glider and the Titan after the first stage has separated, and the glider in flight without the booster, and so on. Test facilities include subsonic and transonic wind-tunnels (for speeds up to Mach 1.4), supersonic tunnels (from Mach 1.5 to 5.5), low hypersonic tunnels (from Mach 6 to 10), and high hypersonic tunnels (from Mach 12 to 25).

Of particular value in the Dyna-Soar programme are the so-called "hot-shot" and shock-tunnels which simulate speeds up to and beyond Mach 20. Although experience obtained with ICBM nose-cones and other ballistic shapes has been very useful in this speed range, it is the wind- and shock-tunnels that have provided the great fund of preliminary test information, gathering data from models on questions of performance, stability and control, aerodynamic and structural heating, flight-loading, etc.

More than 350 people (about 250 at Boeing alone) are directly engaged in the wind-tunnel programme, and virtually every major wind-tunnel in the United States is contributing. Included in this great drive for data are AVCO Research and Advanced Development; Cornell Aeronautical Laboratory; General Electric; the Martin Company; the University of Washington; Ohio State University and the University of Southern California. Also involved are the U.S.A.F.'s Arnold Engineering Development Center and NASA's Ames Research Center, Langley Research Center, and the Jet Propulsion Laboratory. Altogether, some 30 wind-tunnels and shock-tunnels are involved.

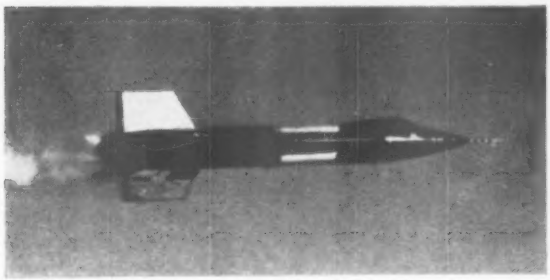
For nearly two years, Boeing research laboratories, continuing earlier work by NASA (Ref. 1), have been engaged in developing coating materials with which to protect the

Survival test for America's Mercury astronaut.

outer skin surfaces of hypersonic re-entry vehicles from deterioration under severe conditions of aerodynamic heating. Two promising structural materials for the glider itself are alloys of columbium and molybdenum. They retain their strength at high temperatures, are available in sheet form, and can be fashioned into complex structures.

The great difficulty is that columbium alloys, when subjected to a hot air plasma, form yellow oxides which melt at around 2,650°F., when the exposed base metal becomes incandescent and rapidly deteriorates. Molybdenum alloys give off white smoke and form black scales when heated under similar conditions, and their rate of metal loss is even greater than that of columbium.

The research for a suitable coating material, sparked off by the results of NASA research with the compound W-2 (Ref. 1), led Boeing to investigate a whole range of possible coatings which might afford reliable protection against the



The North American X-15 on an early test flight.

troublesome formation of oxides on the alloys in question; but available coatings proved inadequate to meet the stringent requirements of hypersonic re-entry.

Conditions which the material had to satisfy were exacting indeed. In addition to retaining its base-metal properties and its ability to transfer heat rapidly at high temperatures, the coating had to be oxidation-resistant under stress, vibration and conditions of vacuum. It had to be easily reproducible both in its physical and chemical characteristics, repairable if damaged, and chemically compatible with adjoining materials. It had, moreover, to be readily applied to complex joined parts.

The coating material which has been evolved to meet this stringent specification consists of silicon and other materials, but its success depends upon the method of its application to the metal. Boeing have successfully applied the coating to test parts at one of their factories in Seattle (Ref. 2).

The coating process—called Disil—involves placing the part to be coated in a retort containing blended powdered materials. The retort is sealed and heated in a furnace to a temperature of between 1,700 and 2,000°F.

After spending some time at this temperature, the retort is pulled from the furnace and allowed to cool, and the parts are unpacked. The result is a hard black coating less than 0.01 in. thick which has good erosion resistance, is non-porous, and has good shock resistance, with good self-healing properties above 2,500°F. It remains stable at temperatures of more than 3,200° F., and weighs only 0.01 lb./sq. ft.

Boeing reported that negligible weight changes occur when the coated metal is heated to 2,700° F., and exposure in oxidizing gas streams for more than an hour at 3,000° F. has not detrimentally affected the coating. Moreover, specimens heated to 2,700° F. and loaded to 8,000 lb./sq. in., have demonstrated the coating's ability to protect the metal while under stress and heat in an oxidizing atmosphere.

So far as columbium alloy is concerned, a Disil coating has been found to be fully protective for a test period of 105 minutes at 3,000° F. and for 15 minutes at approximately 3,400° F.

Dyna-Soar Boosters

Early test flights of the unmanned Dyna-Soar beginning in 1963 will be made at speeds exceeding Mach 20 and will last for approximately 30 min., according to Dr. Yusuf A. Yoler of the Dyna-Soar project team, speaking at the national aeronautics meeting of the Society of Automotive Engineers in New York on Apr. 5. He compared this time with the scant few seconds which were now available with free-flight testing of scale models or parts mounted on rockets or nose-cones. At the present time, he said, it is not possible to simulate simultaneously all the environmental conditions of hypersonic and space flight merely by using ground facilities.

The test programme for Dyna-Soar calls first for unmanned flights down the Atlantic Missile Range from Cape Canaveral; then, manned flight over the same course, and after that, manned orbital flights. The original intention was to employ the Titan I two-stage booster for sub-orbital tests, but a decision by the U.S.A.F. on Jan. 13 this year has put Titan II into this rôle to the exclusion of the earlier vehicle.

Not only is this missile larger and more powerful than the original Titan but it employs storable propellents. The engines, produced by Aerojet-General, have fewer moving parts which has led to further simplifications throughout the propulsion system, and in every sense Titan II should have greater reliability.

A change to Titan II has been made possible by rapid progress which has been made in the missile's development programme; first launching of the basic missile is expected early next year.

The new two-stage rocket will be capable of launching the glider at sufficiently high velocities to simulate the temperature and aerodynamic characteristics that will be encountered during re-entry, which it is one of the primary objects of the Dyna-Soar programme to explore. Contrary to some reports, however, Titan II will not be capable of putting the glider into orbit.

Mr. J. R. Dempsey, manager of Convair Astronautics, has stated that the vehicle will place 8,000 lb. into orbit at 80 miles, but Dyna-Soar weighs more than this and, in any case, is intended to orbit at 300 miles. Thus, orbited flights of the Dyna-Soar will require further up-rating of the booster, perhaps the addition of a high-energy third stage, or possibly the substitution of the 1.5m. lb. s.t. Saturn.

Control Problems

A year ago a question to be resolved was how effective Dyna-Soar would be in flight at high angles of attack relative to the Earth's surface. This incidence must be maintained in the thin air at great altitudes simply to keep the vehicle in level flight. It has been discovered that the control surfaces originally designed for the glider were less effective at hypersonic speeds and at high angles of attack, and it was necessary to design larger control surfaces of different shape.

Design problems have been complicated by the need to

Artist's impression of a Dyna-Soar boost-glider in flight.

develop a vehicle which is capable of operating over a wide velocity spectrum, from low subsonic to orbital velocity. Early in its design life, Dyna-Soar resembled a "manned missile" much more than it does today and its operation was regarded as virtually automatic. Now Boeing are finding more use for the pilot and a number of support systems are being duplicated. Thus the pilot will be free to select an alternative system and, to a large extent, take command of operations.

Weight continues to be a most serious problem. Everything the designers wish to do for improved safety and performance means making the glider heavier and there have been reports that the design weight has been pushed up from about 9,000 lb. to around 11,500 lb.

Once again, to put the present Soviet accomplishments into perspective, it must be remembered that the man-carrying spacecraft recovered from orbit on Apr. 12 weighed over 10,000 lb. and that the experimental sputnik, sent into orbit on Feb. 4, a week before the launching of the Russian Venus probe, exceeded a weight of 14,000 lb. If the Russians are intent on a "Dyna-Soar" of their own—as has been reported on several occasions—they already possess a suitable booster. America will not have this capability, at the earliest, before 1963.

Guidance and Control

Boeing have awarded Minneapolis-Honeywell the contract to provide flight-control electronics for Dyna-Soar. To a large extent this will be equipment which has been developed and tested in other vehicle systems. The inertial platform, for example, is virtually the same as that used in Centaur, the gyros of which have been in production for more than three years. Much of the other equipment, including a digital coupler and power supply, a computer for the inertial guidance sub-system and the automatic flight-control system, will also largely be tried and proven by the time of the first launching (Ref. 3).

One of the major design problems is to provide a control system for Dyna-Soar which is economical in its power demands. The use of gas-jet reaction controls for high-altitude vehicle stabilization and manœuvre requires the expenditure of much more power than that normally involved with aerodynamic controls. Therefore, a system is being developed which makes maximum use of aerodynamic controls and uses reaction controls only when the effectiveness of the aerodynamic controls falls below a set value.

The heart of this system is an automatic gain changer, the output of which is inversely proportional to the effectiveness of the aerodynamic controls. When the gain changer output level exceeds a certain value, the reaction controls are phased in. When it falls below a second predetermined level, the reaction controls are phased out.

As Dyna-Soar will be an unpowered glider during the greater part of its flight, "energy management" becomes a vital concern, requiring rapid and accurate computation between the amounts of kinetic energy to be dissipated during the drag braking re-entry manœuvre and the potential energy remaining in the glider for control purposes. These energies must be constantly compared in such a way that the pilot is allowed a maximum of descent and landing manœuvrability.

Dyna-Soar Budget

Most of the structural and aerodynamic design features of Dyna-Soar have now been settled and a mock-up of the complete glider should be completed by late summer. Construction of the prototype will begin sometime after that, according to present schedules, depending on the time-table set by the U.S.A.F. and the Department of Defense.

Apart from Minneapolis-Honeywell, other sub-contractors appointed by Boeing are Chance Vought, who will provide a ceramic nose-cap, and the Radio Corporation of America who are looking into the design of radio equipment. A particular problem with the latter is that during hypersonic flight on the return from orbit, an ionized "plasma sheath" will envelop the glider, impeding the reception and transmission of radio signals.

Boeing have also placed a $75,000 sub-contract with the Bendix Corporation for a unique undercarriage system in which an inverted metal "toadstool" replaces the conventional nose-wheel. Wheel and lubricated bearings are rendered impracticable by the high temperatures created during re-entry, and a contract to develop an aft landing gear of still less conventional design is expected to be placed shortly.

At present, the biggest news concerning the project is the amount which will be allocated to it in President Kennedy's budget for the fiscal year 1962. Under the heading of Systems Research, $226 million is proposed for Dyna-Soar, Advent, Defender, Discoverer, etc., and of this Dyna-Soar's share is expected to be about one-third. This, of course, would be in addition to the $70 million already budgeted for the project.

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2. Cona, D. A., "Spacecraft Coat," *Boeing Magazine*, December, 1960, pp. 10-11.
3. Yingst, P., and Seacord, C. L., "Dyna-Soar to Depend on Proven Parts," *Missiles and Rockets*, Feb. 27, 1961, pp. 45, 46 and 51.

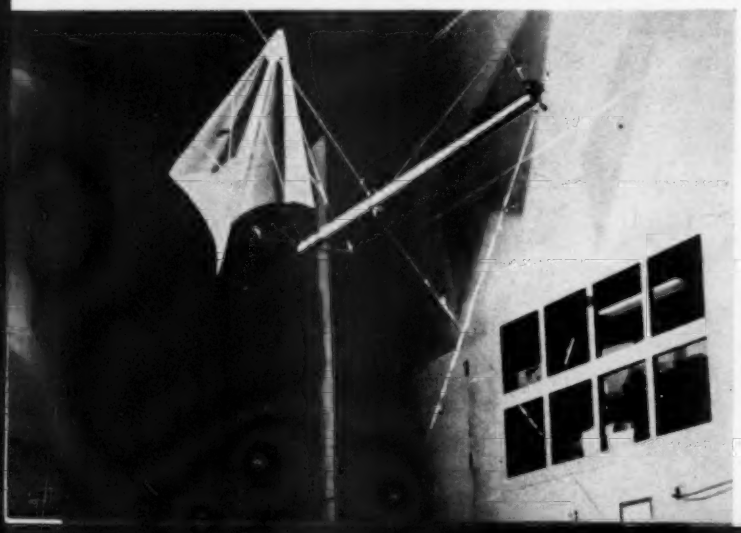
Inflated Recovery Vehicles

IN the United States increasing attention is being given to devising ways of recovering large rocket boosters, both as a means of post-flight inspection of prototypes and as a possible method of reducing the cost of routine space programmes through the salvage and re-use of boost components. NASA's Langley Research Center at Hampton, Virginia, has been especially active in investigating the so-called "para-glider" concept which, as its name implies, owes something to both the parachute and the glider in its solution to this problem.

A model of a para-glider is shown in an accompanying photograph undergoing ejection and opening tests in a wind-tunnel. The results have given promise of leading to a low-weight device which can be compactly stowed on the booster. To be successful, a vehicle of this kind must be capable of ejecting at high supersonic speeds and supporting heavy loads as well as having suitable aerodynamic characteristics for gliding under radio control to a preselected area and landing at moderate speed. To investigate these and other possible recovery techniques in more detail, NASA has recently arranged contracts with two leading industrial concerns, North American Aviation, Inc., and Ryan Aeronautical Co.

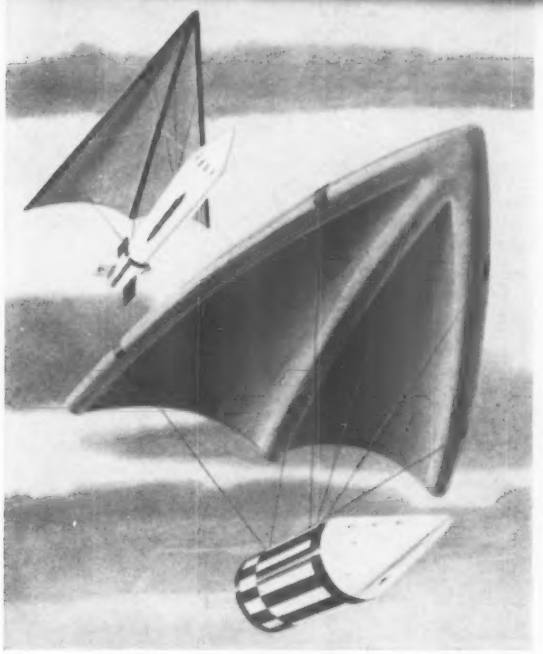
An artist's impression shows the para-glider concept related to the recovery of rocket hardware. The device can be stowed in either a long or short package. Ejection can then be achieved by inflating a three-tube structure (a tube being fitted at each leading-edge of the para-glider wing and at its centre) under gas pressure, thereby forcing the para-glider from its container; or, alternatively, releasing it after the container has separated from the booster.

In the photograph of a wind-tunnel model, the device has been ejected from the aft end of a long tubular container such as might be accommodated down the side of a large booster such as that of the Saturn C-1. In our article "Saturn Project



A "para-glider" in the wind-tunnel at NASA's Langley Research Center in Virginia.

Howard Levy photograph



Possible configurations of "para-gliders" for booster recovery. The vehicle in the foreground has inflated wing leading edges and an inflated central spine. Such gliders might be landed on a "mattress" runway.

Reviewed," published on Apr. 6, we mentioned that the present studies were particularly related to the problem of recovering this big first-stage booster which has a dry weight of some 100,000 lb.

The studies, however, do not end there. Ryan Aeronautical has also received a contract from the U.S. Army Transport Corps for the construction and flight-testing of a flexible-wing aircraft test-bed which should provide useful experience for various applications, among them cargo and personnel dropping, and emergency recovery of VTOL jet-aircraft, as well as rocket boosters.

Apart from these research studies, NASA has also been keeping a close watch on the possibilities of inflatable techniques for recovering payloads from orbit. The extreme goal appears to be a light weight winged vehicle which can be sent into orbit in a folded condition within the nose-cone of a launching rocket and inflated in space to be used for transporting men and equipment back to the surface. To say that such a device would also have its difficulties is an understatement, for inflated portions of a typical re-entry vehicle may encounter temperatures as high as 1,500° F.

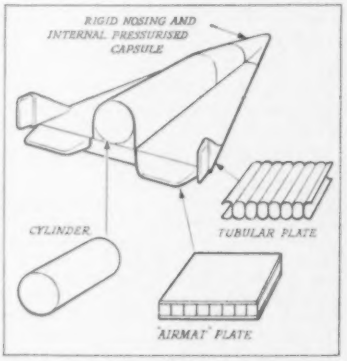
To meet this condition, NASA has concluded that such gliders must be constructed of a woven fabric of high temperature resistant metal wire. This fabric must then be sealed against loss of air pressure by a suitable temperature resistant coating. A similar technique has, in fact, been suggested for the fabric of para-gliders which operate in the higher speed range; they may embody a coating of silicon compounds.

A NASA report giving this information has recently appeared under the title, "Structural considerations of inflatable re-entry vehicles" (Ref. 1). This outlines "the state of the art" for inflatable structures of the type which may be applied to re-entry vehicles, considers the properties of materials, calculates the buckling and collapse loads and also those concerned with deflection and vibration frequencies. It includes a new theory for the analysis of inflated plates and compares the results with experiment.

In spite of the obvious difficulties, material development for inflatable re-entry structures is considered to be well advanced. This status, the report concludes, has been achieved with modest effort and suitable constructional materials "can probably be produced in the near future."

Reference

(1) Leonard, R. W., Brooks, G. W., McComb, Jr., H. G., "Structural considerations of inflatable re-entry vehicles," Langley Research Center, Langley Field, Hampton, Virginia, Sept., 1960 (Tech. Note D-457).



Typical inflatable re-entry vehicle configuration (from NASA Tech. Note D-457).

Britain's Space Company

THE CONSORTIUM of companies formed earlier this year under the name of The British Space Development Company has now begun work on its future plans. Initially, it will be concerned with the use of satellites for communication. The directors of the B.S.D.C. said on Apr. 19 that they intend to examine ways and means by which this country shall assume a significant rôle in space technology. They consider that Britain has the talent and resources necessary to play an important part in the future utilization of space, particularly for commercial purposes.

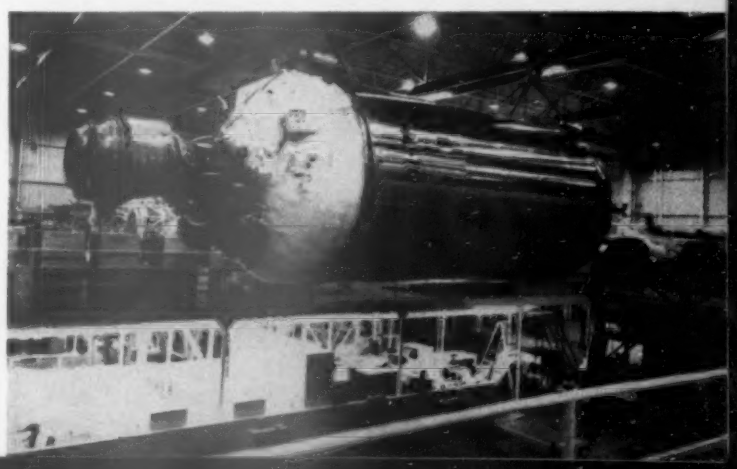
Founder members of the new company are: Associated Electrical Industries, Ltd.; Associated Television, Ltd.; British Insulated Callender's Cables, Ltd.; Decca Radar, Ltd.; Hawker Siddeley Aviation, Ltd.; the Plessey Co., Ltd.; Pye, Ltd.; Rank Television and General Trust, Ltd.; and Rolls-Royce, Ltd.

Sir Robert Renwick, Bt., K.B.E., has been appointed chairman and the following have been elected to the board: Mr. J. R. Brinkley, A.I.E.E., M.Brit.I.R.E.; Gp. Capt. E. Fennessy, C.B.E., B.Sc., M.I.E.E.; Mr. G. C. I. Gardiner, C.B.E., F.R.Ae.S., M.I.Mech.E; Mr. A. A. Rubbra, C.B.E., B.Sc., F.R.Ae.S., M.I.Mech.E.; and Gp. Capt. D. Saward, O.B.E.

A technical committee has been set up under the chairmanship of Mr. G. K. C. Pardoe, B.Sc.(Eng.), D.L.C., A.F.R.Ae.S. Members of the technical committee are: D. E. Burchett, A.E.I.; A. V. Cleaver, F.R.Ae.S., Rolls-Royce; J. M. C. Dukes, M.A., D.I.C., A.M.I.E.E., Plessey; W. F. Hilton, D.Sc., Ph.D., A.R.C.S., D.I.C., F.R.Ae.S., A.F.I.Ae.S., Hawker Siddeley; W. M. Lloyd, B.Sc., A.R.C.S., Rank; L. F. Mathews, M.Brit.I.R.E., A.T.V.; K. Milne, Ph.D.(Eng.), B.Sc.(Eng.), Decca Radar; T. P. Blott, Pye; and G. A. Dodd, A.M.I.E.E., B.I.C.C.

The task of the technical committee will be to examine and prepare plans designed to achieve British participation with the minimum of delay. Its first priority will be to submit proposals for the use of space for communications.

The British Space Development Co., Ltd., has its headquarters at 9 Albert Embankment, London, S.E.1. A full statement covering the company's objectives and its articles of association appeared in our issue of Feb. 10, 1961, p. 132.



BIG TOP.—First picture of the Centaur upper stage which, in combination with an Atlas-D, will be capable of sending more than 8,000 lb. into orbit at 300 miles. Two gimbal-mounted Pratt and Whitney LR-115 engines of 15,000 lb. s.t. power the Centaur stage, which has a thin-wall pressurized s.s. tank structure containing LO_2/LH_2.

Gliding Notes

by Dr. A. E. Slater

FIRST to land a sailplane in Lord Braye's grounds at Stanford Hall, five miles E.N.E. of Rugby, was Geoffrey Stephenson, who flew from Dunstable, a distance of 45 miles, on Apr. 16. But the flight cannot qualify for the Pilcher Memorial Trophy, because it was a Saturday, and the trophy, just presented to the gliding movement by Lord Braye, is to go annually to the pilot who lands there after the longest cross-country flight, provided it is made on a Sunday or Bank Holiday, when the grounds are open to the public and cattle are under control. The flight can include not more than two turning points, and must be made before the end of September.

It was here that Lord Braye's father helped Percy Pilcher, the British gliding pioneer, and an interesting historical lecture on the subject was given to the Kronfeld Club on Apr. 12 by Lord Braye. His grandfather, he related, was once driving back from Rugby after a day in London, when he caught sight of 65 people, almost the entire staff of the estate, pulling a cable at the run, with Pilcher shouting at them. That evening, at dinner, he remarked: "Mr. Pilcher, don't you think that 20 would be enough?"

On the day of Pilcher's death, he had not only his own "Hawk" but also a Lilienthal biplane ready to demonstrate to a distinguished party. They included several Members of Parliament, Major Baden-Powell (who later invented man-lifting kites for use, I believe, in the Boer War), and someone from Birmingham with a new-fangled contraption called a "moving camera," which he took so many hours fitting together that he never got a photo.

While they were at lunch, a heavy downpour soaked the gliders, with the result that the Hawk's tail boom broke when Pilcher had a quick launch to about 80 ft.

Recently Lord Braye received some old Press cuttings from the daughter of a man who helped Pilcher with his gliding trials at Eynsford in Kent. According to one of them, Pilcher once flew three miles.

I doubted this, because his gliding angle could not have been much better than 1 in 6, and the highest point in those parts is 694 ft. Lord Braye thought he must have flown through upcurrents. Anyway, I have been promised a copy of the relevant cuttings from a Sevenoaks paper.

* * *

GOOD lee waves at the London Gliding Club, formed in winds with an easterly component blowing down the west-facing escarpment of Dunstable Downs, are comparatively rare, and appear at average intervals of about three years—at least, at week-ends. But Sunday, Apr. 9, produced one of the best, in a light easterly wind.

It was discovered at about 17.00 hrs. by George Scarborough in a T-21. From a launch to only 600 ft. he passed over the clubhouse with 3 ft./sec. lift which increased to 10 ft./sec. in patches, and rose to a ceiling at 2,300 ft. After that a lot of people had a try, contacting the lift easily just west of the Tring road, about 1,000 yards to leeward of the escarpment, in all sorts of machines from Tutors and T-21s to Olympias and Skylarks, as well as a Swallow flown by a visitor, Godfrey Harwood.

All found the same ceiling at 2,300 ft. or just above, i.e., 10 times the height of the escarpment. There was a very low-lying wave cloud with a base not much above 1,000 ft., and they climbed in front of it into quite clear air, from which they looked down upon the smooth upper surface of the wave cloud, which had looked ragged and ill-defined from the murky air below. Evidently the wave motion embraced the boundary between two very different bodies of air.

To find the state of the atmosphere one has to interpolate between data (kindly supplied by Dunstable Met. Office) from Crawley and Hemsby, not only in space but in time, for the balloons go up only at noon and midnight. There was a strong inversion between 1,500 and 2,000 ft., but there were no wind reports intermediate between E., 10 knots, on the ground and S., 6 knots, at 3,000 ft. Actually it was calm at the launching point, just in front of the wave, but above that pilots soared in an E. wind all the way up to their ceiling.

I cannot see that a wind shear (the officially accepted major cause of lee waves) could have played any part in this wave. It must have been due to the strong inversion (warm air above cold), such as was present in all previous lee waves at Dunstable.

* * *

NO World Gliding Championships will be held next year. The Gliding Commission of the F.A.I., when it met in the middle of April, had still not received a single offer to organize a meeting. So, although the Commission decided in 1958 to hold contests every three years, and then reversed the decision and held one in 1960, circumstances have now enforced a three-year gap after all.

In a letter from the Soaring Society of America, Mrs. Rose Marie Licher writes that, although the United States could not submit a bid for the 1962 meeting, "our National Aero Club is still investigating all possibilities." The idea of holding a small informal international meeting next year in England is being mooted by a few people, but is still only in the stage of being thought about.

Meanwhile there is this year's national contest in Poland from Jne. 4 to 18 at Leszno, to which invitations are being sent to Austria, France, Italy, Switzerland, Great Britain, and all Eastern European countries. Each will be asked to send two pilots "on the exchange principle," Mr. Adam Zientek writes, and 40 Polish pilots are expected to take part. It is to be a "one design" competition, with everybody flying the Mucha Standart type, presumably including the foreign competitors.

Soaring weather in Poland has already been boiling up nicely, starting with a two-seater flight of 162 miles in mid-March from Jelenia Gora (formerly Granau). Thermals at Leszno on Mar. 20 provided four hours' local soaring and one pilot went 120 miles on an attempted 200-mile goal flight. On Apr. 9, temperature at Leszno was 75°F. in the shade, and when a cold front broke through next day, four Mucha Standarts and a Jasolka exceeded 300 km. (186 miles) and another pilot flew 217 miles from Poznan into Czechoslovakia.

But Mr. Zientek's dates seem to be a day out. According to the weather charts, these events must have happened on Apr. 8 and 9, and shade temperatures reached 80.6°F. to the S.E. of Poland on Apr. 8, while Warsaw, just behind the approaching cold front, had only 53.6°F.

BOOK REVIEW

CUSTOMS AND TRADITIONS OF THE ROYAL AIR FORCE. By Sqn. Ldr. P. G. Hering. 243 pp.; 4½ in. by 7½ in. Illustrated. Gale and Polden, Ltd. 15s.

HERE is a modestly priced, unique book which will be widely read and, I hope for the author's sake, widely bought, although even so, his chief reward will be the gratitude of past, present and future members of the British air forces for the years of research and compilation he has put into its 243 pages. Sqn. Ldr. Peter Hering does more than just set out R.A.F. customs and traditions and explain how they have been dictated by usage, common sense, vanity and pride in the Service—he has also, and inevitably, written an intimate history of the Royal Air Force.

The book ranges from the ballooning of the Royal Engineers in the '80s, through the origins of the R.F.C., the R.N.A.S. and the R.A.F., the Service's part during and between two great wars, ending with the establishment in 1958 of St. Clement Danes as the R.A.F.'s own church. Twenty-three chapters deal with, among other subjects, the R.A.F.'s Motto, Ensign, Colours, Standards, Badges, Medals, Mess Customs, Fly-pasts, Mascots, Music, Uniforms, and the Women's Royal Air Force.

Most readers will discover something new—for instance, did you know that an artist on the staff of Gieves, Ltd., the outfitters, was probably responsible for the finalized design of the R.A.F. Badge? And, had first thoughts on the names of ranks prevailed, Sir Dermot Boyle, who wrote the book's foreword, would have been a Reeve and an Ardian during his progression towards becoming a Marshal of the R.A.F.

Some aircraft markings are shown in colour. This reviewer got a smug pleasure from seeing among them his own design for the Auxiliary Fighter Squadron's triangular motif.

The photographs of pre-War uniforms and parades will nostalgically delight those who knew the R.A.F. when it was of a size which allowed everybody to know almost everybody else, a pleasantly club-like condition which the Service, in these days of contraction, is again returning to. Famous names, great occasions and well-known establishments all have a place in this fascinating book.—WREN.

Aviation News in General

DEFENCE EXERCISE.—The annual United Kingdom major air exercise will be held between May 10-16. Designated "Mayflight/Matador," the exercise will take place above 30,000 ft. and aircraft taking part will conform to normal A.T.C. procedures below that height.

RESCUE ROTORCRAFT.—Australia has ordered eight Bell 204B helicopters, a variant of the U.S. Army's HU-1B Iroquois, at a cost of £1,488,000. These will equip No. 9 Sqn., R.A.A.F., based at Williamstown, N.S.W., operating in the search and rescue rôle.

727 TURBOFAN DETAILS.—Test cell operations have begun with the Pratt & Whitney JT8D turbofan, three of which will power the Boeing 727. Initial flight tests will be made in a test-bed aircraft later this year. Having a 14,000 lb. take-off thrust the JT8D weighs 2,988 lb., measures 42¼ in. in diameter and is 122.5 in. long. It has a compression ratio of 15.5, and a 13-stage compressor which includes two fan stages, and a four-stage turbine. By-pass ratio is 1.1 : 1.

TURBOPROP GO-AHEAD.—At a recent meeting of the Secrétariat Général à l'Aviation Civile, the development of small turboprop transports was reviewed. Selection of the Max Holste Super Broussard for Government support in this category was confirmed by the committee.

MORE JETSTARS.—The U.S.A.F. plans to purchase 10 more Lockheed JetStars with fiscal 1962 funds. They will be support aircraft, designated T-40. Eleven JetStars already ordered for MATS are designated C-140.

MORE F-104s?—Production of about 300 Lockheed F-104s by Canadair for the Greek and Turkish Air Forces is being negotiated in Ottawa. The aircraft would be financed by the U.S. through M.D.A.P.

A HUREL DUBOIS PROJECT.—Latest entry in the competition for an assault transport for the French military forces is the Hurel Dubois HD-130. Based on a high-aspect ratio wing, the HD-130 has a short, circular section, pressurized fuselage with a swing tail, and is powered by two Astazou II turboprops. Gross weight is 11,460 lb. and the max. payload 2,800 lb.

SKIMMER.—Mr. Donald R. Robertson pilots the Skimmer lightweight hovercraft designed by himself and built by the Chelsea College of Aeronautical Engineering. The project is described on page 447.

LOCKHEED ORION.—The first Lockheed P3V-1 anti-submarine variant of the Electra has been accepted by the U.S. Navy from Lockheed. The type is to be known as the Orion.

GULFSTREAM ORDERS. — Orders for the Grumman Gulfstream now total 72, and production is being increased from two to three a month.

CRASH CAUSE.—According to the U.S.A.F. the cause of the crash of a B-52 in California last month was lack of fuel. A faulty fuel gauge had given the pilot a false indication of his endurance.

REVERSED MOVEMENT.—In Dr. A. E. Slater's account of the lecture on "Insect Flight" given by Dr. Pringle to the R.Ae.S. Man-powered Aircraft Group (THE AEROPLANE AND ASTRONAUTICS, Mar. 3, p. 241) the muscular wing movement discussed was inadvertently reversed. The vertical muscles inside the thorax cause the wing root to go down and the rest of the wing to go up, not the other way round.

WEST INDIAN SURVEY.—A contract for the aerial survey of the 4,411 sq. miles of Jamaica has been awarded to Hunting Aerosurveys, Ltd. This is to be done by an aircraft of Hunting's Canadian associates which recently arrived in Kingston.

ORBITAL MERCURY.—Preparations at Cape Canaveral were advanced this week for the first attempt to orbit an unmanned Mercury space-capsule. Launching vehicle is a modified Atlas-D, and the capsule is planned to orbit at a height of some 100 miles, with re-entry triggered after some 90 minutes. Total flight duration should be about 110 min., with recovery some 300 miles east of Bermuda.

NOT YET!—The Kennedy Administration has reversed the former Administration's policy of encouraging private industry to launch communication satellites.

VENUS PROBE.—Soviet astronomer, Prof. Alla Massevich, has stated that Russia had not lost hope of re-establishing contact with the automatic interplanetary station which is heading for a rendezvous with Venus. Estimated date of "fly-by" is May 19-20.

UNSTABLE.—An orientation fault in the satellite Discoverer XXII, launched from Vandenberg A.F.B. on Apr. 8, resulted in the 300-lb. re-entry capsule remaining in orbit. It was commanded to eject during the 31st orbit.

B.I.S. AWARD.—Major Yuri Gagarin, the Soviet astronaut, may visit Britain possibly at the time of the Soviet trade fair at Earls Court in July. The British Interplanetary Society is to present him with a special award.

SEVEN STAGES.—The United States launched a seven-stage research rocket from Wallops Island, Virginia, on Apr. 21. Final stage carried an "artificial meteorite"—a steel pellet—which was fired back into the Earth's atmosphere at about 25,000 m.p.h.

ROYAL REVIEW.—On Apr. 20 Her Majesty The Queen and H.R.H. The Duke of Edinburgh reviewed the passing-out parade of flight cadets of No. 157 course at No. 1 Initial Training School, R.A.F. South Cerney.

Commercial Aviation Affairs

STILL GOING UP.—The number of passengers handled at U.K. airports during January, 1961, showed a 26% increase over the same month in 1960, at 563,189. The number of air transport movements increased by 9%, and freight picked up and set down by 7%. Airports in the London area showed an above-average increase in movements, at 13%.

BACK TO MANCHESTER.—As recorded in last week's issue (p. 423) B.O.A.C. will resume its Boeing services through Manchester on May 1. While the work on the runway was in progress, DC-7Cs were used to connect with transatlantic services at Prestwick. Most of the new 130-ft.-high tower at the airport has also come into use.

AIR ARAB PLANS.—Reports from Baghdad suggest that delegates from Arab states meeting there recently agreed to the formation of a single Arab international airline. United Arab Republic and Iraq would each subscribe 20% of the capital, and Kuwait and Saudi Arabia 15% of the capital. Yemen and Lebanon are also expected to participate.

PASSENGER LIABILITY. — The Carriage by Air Bill, now past the report stage, increases the maximum liability of airlines on international flights for personal injury to passengers from £3,000 to £6,000.

K.L.M. PROFIT.—A profit of just over £1 million was made by K.L.M. in 1960, the tenth successive profitable year of operation. During the year, 19% increases were achieved in capacity ton-miles offered and revenue ton-miles flown, but the expansion of low-fare traffic kept the revenue increase down to 12%; operating expenses, including depreciation, increased by 14%.

SERVING DUNDEE. — Scheduled services between Dublin and London (Gatwick) and Dublin and the Isle of Man will be started by Dan-Air on Jne. 1, using the Royal Naval Air Station at Arbroath (H.M.S. "Condor"). From Jly. 7, the existing Dan-Air services from Plymouth, Bristol, Cardiff and Liverpool to Newcastle will be extended to Dundee. All services will be operated by 36-seat DC-3s.

IRISH YEAR.—Aer Lingus (Irish International Airlines) carried a record 742,000 passengers in the year ended Mar. 13, 1961, with a 25% increase on European routes and a 52% increase on transatlantic services. A surplus is expected to be shown on the year's operations.

AIR SAFARIS INAUGURAL.—The first Air Safaris scheduled service from Hurn was flown on Apr. 8, to Amsterdam, by Viking. The company, which will begin services to Dublin, Belfast, Birmingham, Newcastle, the Isle of Wight and Exeter this year, now has a fleet of four Hermes and eight Vikings, for which a distinctive new colour scheme has been adopted (see photograph below).

PASSAGE TO INDIA.—On Apr. 21-22 an Air India Boeing 707 (VT-DMN "Kanchenjunga") flew the 8,500 miles between New York and Bombay in 16 hr. 55 min. with only one stop, of 94 min., at London Airport. This is the fastest time recorded for the route and was only the second non-stop flight between the U.K. and India.

L-1049s RETIRED.—K.L.M. has now withdrawn Super Constellations from all its scheduled long-haul routes. They will continue to be used on some European routes in peak periods and for charter flights.

BAD FORTUNE.—The long-disused airfield at East Fortune, brought into use while work is in progress on the runways at Turnhouse, Edinburgh, became unserviceable on Apr. 15 when the runway began to break up. Services were diverted to Renfrew until temporary repairs could be effected.

ETHIOPIAN ANNIVERSARY. — Ethiopian Airlines celebrated its 15th anniversary on Apr. 8 when Capt. O. H. Salyers—who flew the first service on that date in 1946—took the scheduled service for Frankfurt out of Addis Ababa. Nearly 32 million revenue aircraft miles have been flown; in 1960, the company carried 104,000 passengers compared with 8,000 in 1946.

ANOTHER S-62 FOR JAPAN.—The Nitto Airlines Co., of Osaka, has ordered a Sikorsky S-62 turbine helicopter for delivery in May. An S-62 is also on order for the Fuji Airlines Co., of Tokyo.

BIG CARGO.—A 13,262-lb. consignment of oil-drilling equipment for a company in Bombay was recently flown across the North Atlantic and on to Bombay by Air India in a Boeing 707.

NOT SO MANY.—Encouraging as has been East African Airways progress of late, it does not yet support a fleet of 39 Comets, as a typographical error led us to suggest in our Apr. 13 issue. The correct figure is 3. The makers also remind us that the D.H. Trident has a drooped leading edge but no slats, as we indicated in the table of turbojet transport engineering features in the same issue.

NEW LINE.—Distinctive new markings—seen here on a Viking—have been adopted by Air Safaris, and include a claret trim line down the fuselage, green lettering on the white top, and a white A/S motif on the green fin.

News About People

SMITHS P.A.—Gp. Capt. P. P. W. Sands has joined Smiths Aviation Division as personal assistant to the director and general manager, Mr. L. A. Morgan.

HONEYWELL MANAGER. — In addition to continuing as Birmingham manager of Honeywell Controls, Ltd., Mr. W. R. Owen has assumed responsibility for the company's Cardiff and Manchester branches.

SOLARTRON SALES. — Mr. T. Morrison has been appointed group field sales manager, U.K., of the Solartron Electronic Group, Ltd.

BELLING MANAGER.—Dr. A. C. Robb has been appointed technical manager of Belling and Lee, Ltd.

B.O.A.C. CHANGES.—In order to strengthen the sales effort and, in particular, to apply more pressure to air cargo sales, B.O.A.C. is, from May 1, abolishing the post of sales manager, U.K., and making two new appointments. These posts are: passenger sales manager, U.K., to be held by Mr. G. R. Deshayes; and cargo sales manager, U.K., to be held by Mr. E. C. Engeldew. The present sales manager, U.K., Mr. A. R. Bennett, is being appointed special assistant to the general sales manager.

AERO GOLF.—The first Spring Meeting of the Aero Golfing Society was held at Wentworth on Mar. 24. The Hunting Trophy, being competed for, was appropriately won for the first time by the Society's President, Lord Brabazon (82-15 nett 67); runner-up D. P. Hepburn (76-7 nett 69). The afternoon's Two Ball Stapleford competition was won by I. D. Roxburgh and Gp. Capt. F. L. Dodd; runners-up R. F. D. Anstead and Major R. de la Hey. Lord Brabazon was again successful at the St. George's Hill meeting held on Apr. 20, winning the Instone Challenge Trophy (86-15 nett 71). A. Gough (82-8 nett 74) was runner-up. K. F. Alder and E. Bullman won the Four Ball Stapleford match by one point from W. R. K. Silcock and T. Read.

TEST PILOT.—Mr. L. J. Roberts has joined the flight test department of Bristol Aircraft, Ltd., as a test pilot. After service in the R.A.F. and a course at the Empire Test Pilots School he served with B Sqn., A. and A.E.E., Boscombe Down, flying Valiants, Vulcans and Shackletons.

FERRANTI MANAGER.—Mr. H. G. Hinckley who established and managed the Ferranti, Ltd., trials and flying units at Edinburgh in 1948, has been made manager of the company's machine tool control department.

SIR LEONARD SLATTER.—We regret to record the death of Air Marshal Sir Leonard Slatter, K.B.E., C.B., D.S.C., D.F.C., on Apr. 14, aged 66. He retired in 1948 after three years as A.O.C.-in-C. Coastal Command.

AIR CDRE. INNES-CRUMP.—It is with regret that we record the death on Apr. 19, after 25 years in the R.A.F., of Air Cdre. J. E. Innes-Crump. He was Director of Air Staff Briefing at the Air Ministry.

Vacuum Cast Alloys for Turbine Blades

By B. Cartwright, A.I.M.*

AS the thrust developed by a gas-turbine engine is directly related to the gas temperature, the natural development trend is always towards "hotter" engines.

Maximum gas temperature is, however, restricted by the strength of the turbine blade material as over-heating will result in blade failures. As higher creep strength alloys are developed, engines can be run at higher maximum temperatures and they are often upgraded in this manner by a change to an improved blade material.

Until recent times, wrought turbine blades in this country have been made almost exclusively from the nickel-base alloys in the Nimonic series, hardened with titanium and aluminium.

For the future there exists the series of super heat-resistant materials such as molybdenum, niobium and tungsten which are in use in some experimental engines. At present these materials are so expensive that they do not compete economically with those alloys in use in commercial conditions, and additionally molybdenum and niobium have inadequate oxidation resistance. This latter point is currently the subject of extensive development work with the object of finding a suitable protective coating for these materials.

Fig. 1.—A Proteus turbine wheel fitted with precision cast blades in Vacumelt G.64.

The designer's preference has always been towards forged blades but the obvious consequence of an improvement in material hot strength is increased forging difficulty. The forgeability of some of the latest developments is marginal—to the extent that extrusion has become the only way by which fabrication of ingot to bar stock can be started. Other experimental alloys of improved creep resistance are forgeable but only in such a narrow temperature range that their use for production purposes is impractical.

The next upward step therefore is towards casting alloys which are not limited by hot forging difficulties. Precision cast blade assemblies have been used in gas-turbine engines for some years as stator or nozzle guide vanes and, additionally, cast rotor blades are widely employed in the United States. There has been some reluctance on the part of British engine manufacturers to use the available casting alloys for rotor blades as it was felt that they were relatively brittle compared with wrought alloys for such stringent operating conditions.

The introduction of vacuum melting and casting techniques with the resulting improvement in uniformity and quality has led to a revived interest in cast rotor blades, especially those produced from the nickel-base alloys which are precipitation hardened with titanium and aluminium. The expanding application of vacuum processing has led to the evolution of a family of heat-resisting materials which, because of their high content of reactive elements such as titanium and aluminium, can be melted and cast only in vacuo.

From experimental programmes involving many hundreds of melts of varying compositions a series of such alloys has been developed by the Jessop-Saville Research Department. One of these casting alloys for high-temperature applications is Vacumelt G.64 which is a nickel base, chromium alloy, strengthened with aluminium, tungsten, molybdenum and

* Jessop-Saville, Ltd.

Fig. 2.—The precision casting assemblage from which the turbine blades are manufactured.

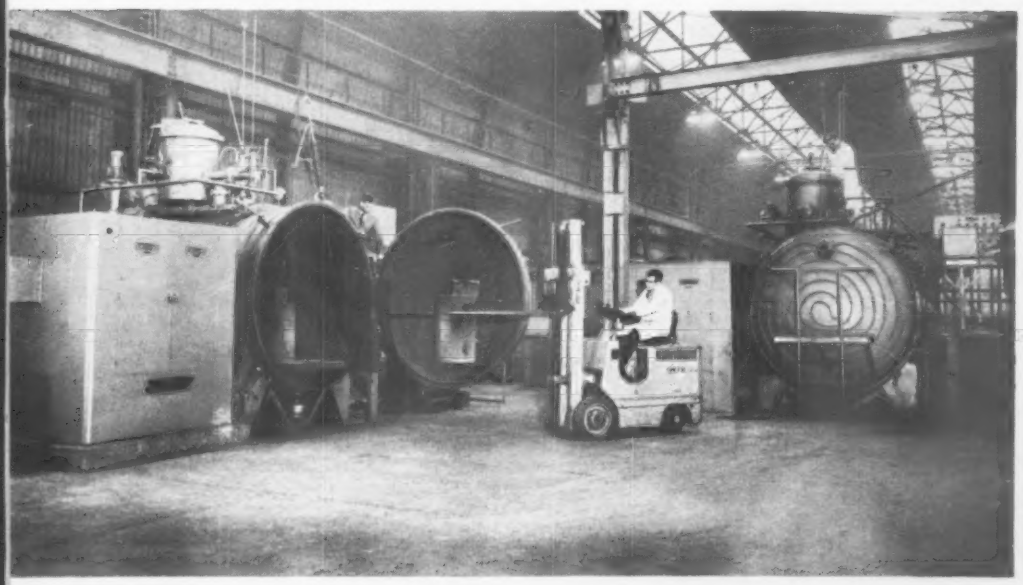


Fig. 3.—Part of the Jessop-Saville vacuum induction melting department showing the two furnaces now in operation.

TABLE 1.

	C	Mn	Si	Ni	Cr	Mo	Ti	W	Nb	V	Al
G.64	.10	.40	.40	BAL	11.0	3.0	—	4.0	2.0	—	6.0
G.74	.12	LAP	LAP	BAL	16.0	—	4.0	8.0	—	—	4.0

niobium. The basic composition of G.64 and a stronger, related, super alloy is given in Table 1.

Precision cast G.64 blades are now in use in the Bristol Siddeley Proteus engine which is installed in the Britannia. A Proteus turbine disc fitted with G.64 cast blades, is shown in Fig. 1 and the appearance of a precision casting assemblage is given in Fig. 2.

Vacumelt G.64 is produced initially by vacuum induction melting and the form of supply is as cast stick, of a size suitable for the precision foundry's remelting facilities. The interior of Jessop-Saville's vacuum induction melting department showing the two furnaces now in operation is illustrated in Fig. 3.

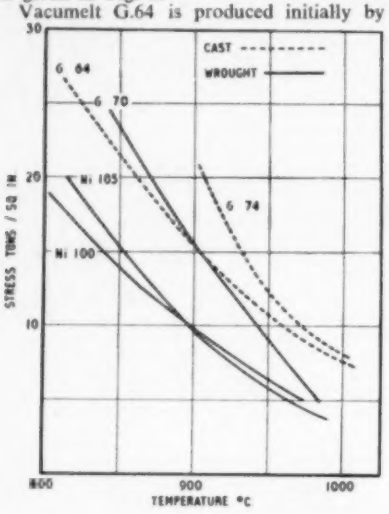


Fig. 4.—Creep properties—stress to give rupture in 100 hours.

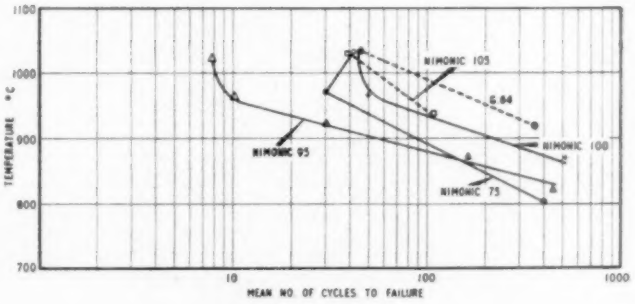


Fig. 5.

The enhanced creep resistance of G.64 can be seen in Fig. 4 where its high-temperature rupture life is compared with that of G.74, another casting alloy, G.70, a nickel-base wrought alloy, and other well known and widely used heat resistant materials.

G.74 is a later development than G.64 and can be seen to be a somewhat stronger alloy over the significant temperature range. This creep strength advance has been found to be supplemented by a high level of thermal shock resistance as evaluated by the N.G.T.E. Thermal Fatigue test. This test is designed to simulate turbine blade conditions and the relationship of G.64 with other well tried blading alloys is outlined in Fig. 5.

Now that the operating life and performance of the Proteus engine have proved the suitability of cast turbine blades, the material is under consideration for other engines of more recent appearance in experimental types. It seems likely that the experience gained will extend the application of vacuum melted and cast alloys for turbine blades now that designers may have more confidence in their integrity.

Industry Record

Secondary Radar Transponders

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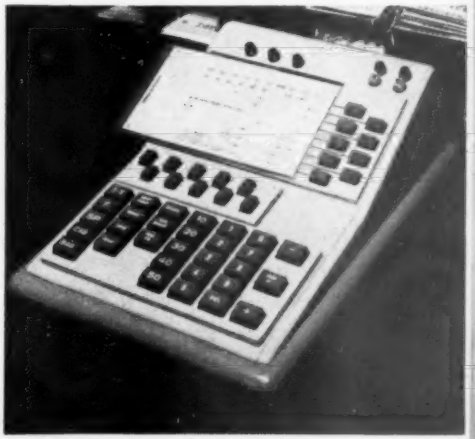

A counter clerk's keyset which feeds weight and passenger details into the central Zebra computer.

Correspondence

Graduates for Maintenance

WITH reference to your editorial in THE AEROPLANE AND ASTRONAUTICS for Apr. 13, I find myself asking, graduates of what?

Aircraft maintenance work (and this in general applies to all engineering maintenance) is so divorced from that undertaken at a university by engineering graduates that in all but a few cases they are lost when they enter this field. Graduates find that it takes years to gain the experience that is so necessary for maintenance work, and that apart from "prestige" value their degree, which is more of a mathematical qualification than anything else, is of little use to them.

An engineering degree is valuable, but not to one who wants to make maintenance a career. What is required is a Degree of Maintenance. Unfortunately none of our universities has yet realized the importance of this class of work.

The only qualifications which have any value for aircraft maintenance work at present are the Aircraft Maintenance Engineers Licence (although the Air Registration Board alone state that this is not a qualification), and membership of the Society of Licensed Aircraft Engineers. This society is the first professional body to draw up a qualification for those working on aircraft maintenance, and their work in this field deserves more publicity than they have had in the past.

It is time that our educationists revised our technical training from degree standard down to apprentice training schemes and brought them more into line with present-day requirements. All too often a young man spends years learning something to satisfy an academic standard drawn up years ago and which no longer meets the technical requirements of this day and age.

The letters that follow a name do not always mean that he or she is the best person for a particular appointment. All too often it points to too much time chasing academical qualifications and not enough time obtaining experience in the field in which he or she intends carving a career.

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Indeed, news of this Russian technological triumph—and triumph it most certainly was—had none of the sheer drama of the very first Sputnik which was seen as a small man-made light speeding swiftly across the sky several nights in succession, on the forecast time and path. That was the real sign in the sky that space had been conquered. And that was when the scientists enjoyed their real hour of acknowledged triumph—for it was then that the inevitability of a Major Gagarin getting into orbit—probably before anybody else—was assured.

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It was not until Mr. Shenstone's lecture at the R.Ae.S. on Apr. 12 that I learnt the configuration of the Italian machine and came to the conculsion that the purported performance was, in fact, very credible.

The difference between the German and Italian machines, not brought to light in the article, lies, I suggest, first in the wing loading—"Mufli" 2.3 lb./sq. ft., "Pedaliante" 1.6 lb./sq. ft.—and secondly in the method of propulsion.

You will already be aware of my firm conviction that human muscles should not be required to achieve more than a bird's muscles or attempt to lift a greater loading than the 1.25 lb./sq. ft. of a bird. The Italian effort came nearest to that.

Regarding propulsion, the German machine had a total airspeed over the wing less than the total slipsteam produced by the pylon-mounted propeller. The Italian had two airscrews mounted directly in front of the wing leading-edge, causing an airflow around a section of the wing, as well as producing thrust, so that the total airspeed over large sections of the wing was made up of ground speed plus natural airflow, plus "built-in" airflow.

It may be of interest to note that the Crouch-Bonomi, was

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1. Tow a Princess to Pembroke Dock, to keep.
2. Importune the French Govt. for a Lancaster.
3. Rescue five Thunderbolts from Rochefort.
4. Lead a campaign to clean up old airfields and Army camps.
5. Get hold of some local tied-up public funds to purchase a beauty spot to save it from becoming a caravan site.

by Gyrene

TABLE 1.

	C	Mn	Si	Ni	Cr	Mo	Ti	W	Nb	V	Al
G.64	.10	.40	.40	BAL	11.0	3.0	—	4.0	2.0	—	6.0
G.74	.12	LAP	LAP	BAL	16.0	—	4.0	8.0	—	—	4.0

niobium. The basic composition of G.64 and a stronger, related, super alloy is given in Table 1.

Precision cast G.64 blades are now in use in the Bristol Siddeley Proteus engine which is installed in the Britannia. A Proteus turbine disc fitted with G.64 cast blades, is shown in Fig. 1 and the appearance of a precision casting assemblage is given in Fig. 2.

Vacumelt G.64 is produced initially by vacuum induction melting and the form of supply is as cast stick, of a size suitable for the precision foundry's remelting facilities. The interior of Jessop-Saville's vacuum induction melting department showing the two furnaces now in operation is illustrated in Fig. 3.

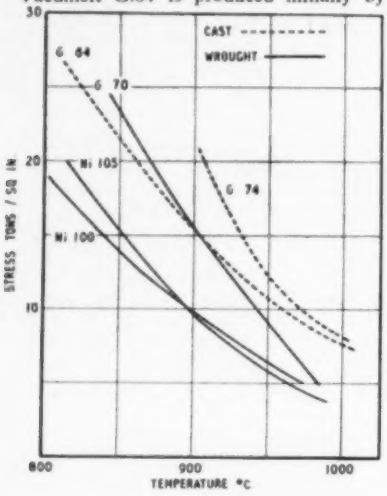

Fig. 4.—Creep properties—stress to give rupture in 100 hours.

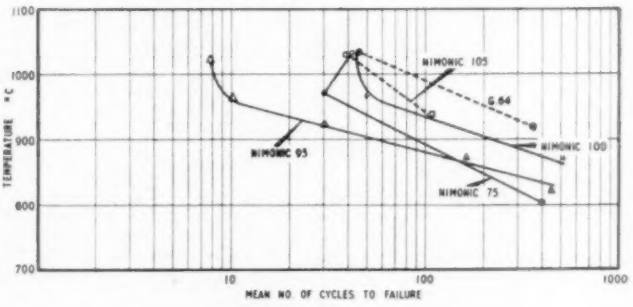

Fig. 5.

The enhanced creep resistance of G.64 can be seen in Fig. 4 where its high-temperature rupture life is compared with that of G.74, another casting alloy, G.70, a nickel-base wrought alloy, and other well known and widely used heat resistant materials.

G.74 is a later development than G.64 and can be seen to be a somewhat stronger alloy over the significant temperature range. This creep strength advance has been found to be supplemented by a high level of thermal shock resistance as evaluated by the N.G.T.E. Thermal Fatigue test. This test is designed to simulate turbine blade conditions and the relationship of G.64 with other well tried blading alloys is outlined in Fig. 5.

Now that the operating life and performance of the Proteus engine have proved the suitability of cast turbine blades, the material is under consideration for other engines of more recent appearance in experimental types. It seems likely that the experience gained will extend the application of vacuum melted and cast alloys for turbine blades now that designers may have more confidence in their integrity.

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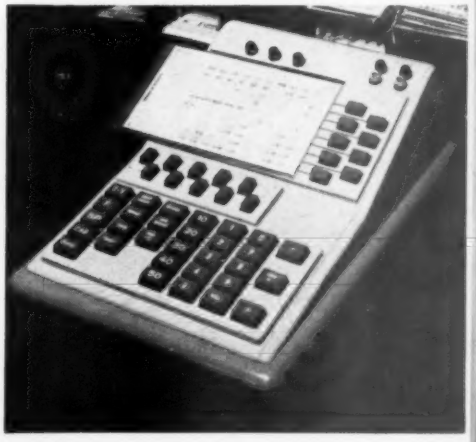

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by Gyrfalcon

Correspondence . . . .

powered by a relatively small engine but lifted at 15 m.p.h. (a figure quoted from memory).

It may also be of interest to note that the Haessler-Villinger craft was reputed to need its driving belt shortened after every flight, and so is likely to have suffered considerable slip during flight. It may not, in fact, have been as efficient as the heavier shafts, chains and gears of the "Pedaliante"—although the reverse was claimed by the author.

London, S.W.2. H. R. BARNARD.

Unfair to Accident Inspectors

I WONDER if you saw "After the Crash" on the B.B.C. Television programme on Thursday, Apr. 13. The theme was a good one, and one in which the general public might be expected to be interested.

However, speaking as an aeronautical engineer who has been closely associated with the Accident Investigation Branch of the Ministry of Aviation over the past 30 years, I feel that I must bring to your notice a most unfortunate aspect of this programme.

I refer to the portrayal of the Investigating Officer. These gentlemen are most experienced and competent engineers, but they were portrayed in the film as bungling amateurs; not only were they shown happily smoking amongst the aircraft wreckage but the shot of one using a camera gave me the impression that he had never handled one before. I was also appalled at the lack of notebook or system in recording and plotting the position of the various pieces of wreckage.

I formed the impression that he was portrayed as a minor adjunct to the Inspector, with whom in fact he operates as an equal.

I feel I must bring this to your notice, as I think this most skilful, painstaking and efficient branch of the Accident Investigation Department has been done much less than justice in this film.

A. C. JACK, A.M.I.Mech.E., M.S.I.A.E.

Levenshulme, Manchester.

G-Suits and Immersion Suits

MAY I refer to THE AEROPLANE AND ASTRONAUTICS for last Feb. 24; in the text to the top photograph on p. 197 is mentioned:—

". . . partial pressure jerkins and g-suits, but this last-named item cannot be worn during the winter months while immersion suits are in use."

The Royal Norwegian Air Force are interested in knowing whether there is any special reason why g-suits and immersion suits cannot be worn together. They add that Norwegian pilots wear both during the winter months.

It would be very much appreciated if you could give some more information on this subject.

London, S.W.1. O. GRONMARK (Lt.-Col., R.N.A.F.)

[One reason why R.A.F. Lightning pilots at Coltishall are unable to wear g-suits and immersion suits together is that the second item, of the two-piece Fleet Air Arm pattern, joins at the waist and has no valve for the g-suit connection.—ED.]

Data Wanted

I WOULD be most grateful if you would publish this appeal to your readers for any information about No. 49 Squadron past and present. We are hoping to write a complete squadron history and any personal reminiscences, anecdotes or photographs will be welcome.

I will of course guarantee to return any photographs, log books or other personal possessions after we have had photostat copies made.

All such information should be addressed to:—The Adjutant, No. 49 Squadron, Royal Air Force, Wittering, Peterborough, Northants.

R.A.F. Wittering. A. I. ALDER (Flt. Lt., R.A.F.).

Publications Received

ABC British Aircraft of World War II, by K. G. Munson. A useful collection of facts and photographs in the familiar ABC format covering 67 types of aircraft used by the R.A.F. and R.N. between 1939 and 1945. 64 pp. 4¼ in. by 7¼ in. Illustrated. Ian Allan, Ltd. 2s. 6d.

The Wild Blue.—The Story of American Airpower, edited by John F. Loosbrock and Richard M. Skinner. An anthology of articles which have appeared in *Air Force* magazine and earlier publications, from 1918 to date, which begins with "Prelude to Kitty Hawk" and ends with a look at space travel. In between are about 100 stories which trace the development of the USAF and tell of its achievements in war and peace. 620 pp. 5½ in. by 8½ in. G. P. Putnam's Sons, New York. $5.95.

Stamps and Aircraft, by James Watson. A book for the thematic philatelist, which illustrates many of the large (and rapidly growing) number of stamps featuring aircraft. Background information is given about the aircraft and events commemorated. 160 pp., 5 in. by 8 in. Illustrated. Faber and Faber. 15s.

Principles of Astronautics, by M. Vertregt. An Elsevier Monograph written to provide a working knowledge of the theories relevant to the various fields of astronautics. 222 pp., 5 in. by 7½ in. Illustrated by diagrams. D. Van Nostrand Co., Ltd. 18s.

The Birth of the Bomb, Ronald W. Clark. A valuable account of the development of the atomic bomb from 1938 to the dropping of the first bomb on Hiroshima, in which the important part played by British scientists is put into perspective. 210 pp., 5½ in. by 8½ in. Phoenix House, Ltd. 16s.

Customs and Traditions of the R.A.F., by Sqn. Ldr. P. G. Hering. This volume provides for the first time a reference source for information on all aspects of R.A.F. traditions, including ranks, uniforms, medals, colours, squadron and unit badges, and much else. 244 pp., 4½ in. by 7½ in. Illustrated. Gale and Polden, Ltd. 15s.

Aviation Calendar

Apr. 28

Coventry Airport.—Shackleton Sales Week-end, until Apr. 30.

Harrow.—Society of Weight Engineers, London Branch Forum on "Design, Manufacture and Operation of Aircraft," at Lascelles School, Shaftesbury Avenue, at 19.00 hrs.

May 3

London.—British Institution of Radio Engineers. Computer and Radar Groups Symposium on "Computer Control of Air Traffic," at University College, W.C.1, at 15.00 hrs.

May 4

London.—R.Ae.S. A.G.M. in the Lecture Theatre, 4 Hamilton Place, W.1, at 18.30 hrs.

May 5

Jersey Airport.—Channel Islands Aero Club International Air Rally; until May 7.

London.—R.Ae.S. Rotorcraft Section lectures, "Transport Rotorcraft Design Trends," by R. Hafner, in the Lecture Theatre, 4 Hamilton Place, W.1, at 19.00 hrs.

May 6

London.—B.I.S. lecture, "An Appraisal of the Society's Technical Contributions to Astronautics," by H. E. Ross and A. V. Cleaver, in the R.Ae.S. Lecture Theatre, 4 Hamilton Place, W.1, at 18.00 hrs.

May 7

Seething.—Wavency Flying Group Light Aircraft Rally.

May 8

London.—R.Ae.S. Historical Group Discussion Evening, at 4 Hamilton Place, W.1, at 19.00 hrs.

London.—Pathfinder Association and Club Annual Dinner, at the Dorchester Hotel, W.1, at 19.30 for 20.00 hrs.

Company Notices

NEW COMPANIES

Flairavia, Ltd. (688,078).—Private co. Reg. Mar. 28. Cap. £250 in £1 shs. To carry on the business of air transport contractors, couriers and tour operators. Directors: David J. Porter and Mrs. Betty D. Porter, both of 8 Hayes Chase, West Wickham, Kent. Sec.: D. J. Porter. Reg. off.: Tower House, College Road, Bromley, Kent.

Flair Aviation Sales Co., Ltd. (688,079).—Private co. Reg. Mar. 28. Cap. £750 in £1 shs. To carry on the business of designers, manufacturers, testers and repairers of and dealers generally in aircraft. Other particulars are similar to Flairavia, Ltd. (q.v.).

Hunting Group, Ltd. (688,522).—Private co. Reg. Mar. 30. Cap. £100 in £1 shs. To foster and co-ordinate the interests of the businesses, undertakings and commercial enterprises which are controlled or managed by Hunting and Son, Ltd., and/or Hunting Aviation Management, Ltd., and/or the shareholders of those two companies who are members of the family of the late Charles S. Hunting. Directors: Charles P. M. Hunting, Merrifields, Lewes Road, Haywards Heath, Sussex. Lindsay C. Hunting, Ethorpe House, Packhorse Road, Gerrards Cross, Bucks. Richard R. S. Hunting, Reginald R. S. Cook and David T. Betts. Sec.: R. E. Treacher. Reg. off.: 4 Dunraven Street, Park Lane, W.1.

New Patents

APPLICATIONS ACCEPTED

869,265.—**A.C.F. Industries Inc.**—"Grounded aircraft trainers."—Dec. 22, 1958.

869,266.—**A.C.F. Industries Inc.**—"Non linear amplifier circuits."—Dec. 22, 1958. (Divided out of 869,265).

869,486.—**Gabriel, Co.**—"Aircraft ejection seat catapult."—Aug. 19, 1959. (Feb. 3, 1959).

Printed specifications of the above will be available on May 31, 1961, and the opposition period will expire on Aug. 31, 1961.

Personal Notices

BIRTHS

Armstrong.—On Apr. 6, to Shirley, wife of Flt. Lt. J. Armstrong—a daughter.

Baker.—On Apr. 8, at R.A.F. St. Athan, to Jane (*née* Hedgecox), wife of Anthony Baker—a daughter.

Barnes.—On Apr. 14, at R.A.F. Nocton Hall, to Ann, wife of Kenneth Barnes—a son.

Brown.—On Apr. 8, at Birmingham, to Joan (*née* Blader), wife of Flt. Lt. J. H. F. Brown—a son.

Checketts.—On Apr. 8, to Leila (*née* Herrick), wife of Flt. Lt. D. Checketts—a daughter.

Cornish.—On Apr. 11, at R.A.F. Wegberg, Germany, to Jill (*née* Woodward), wife of Flt. Lt. A. H. P. Cornish—a son.

Goldby.—On Apr. 13, at the B.M.H., Paris, to Jean (*née* Smith), wife of Wg. Cdr. J. L. Goldby—a daughter.

Goodall.—On Mar. 29, to Helen (*née* Thomson), wife of Flt. Lt. P. J. Goodall—a daughter.

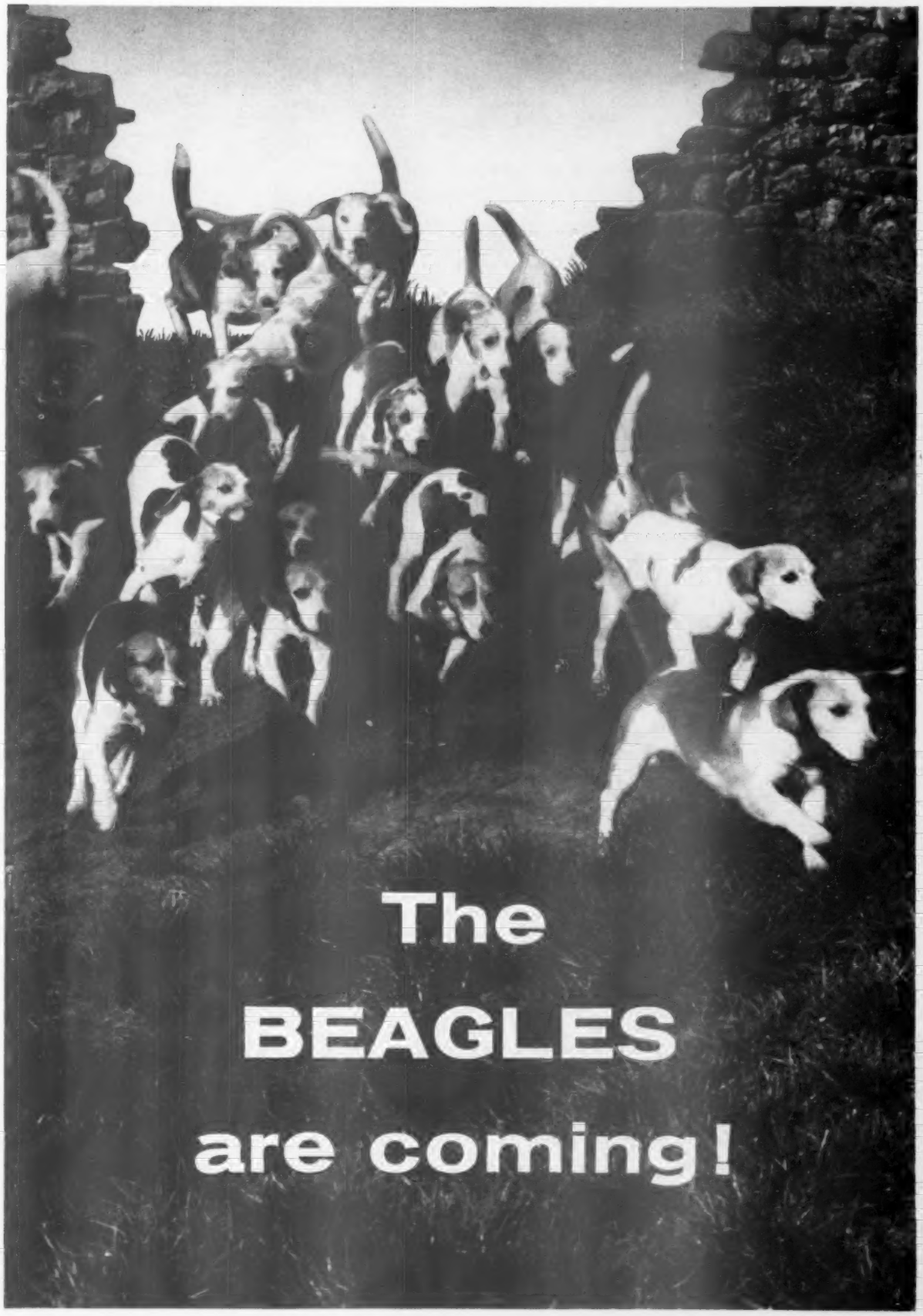
Saunders-Davies.—On Apr. 15, at R.A.F. Hospital, Wroughton, to Olivia (*née* Smith), wife of David Saunders-Davies—a son.

Whittingham.—On Apr. 12, at Moreton-in-the-Marsh, to Helen (*née* Gillespy Smith), wife of Flt. Lt. T. H. Whittingham—a son.

DEATHS

Hodgson.—On Apr. 7, at R.A.F. Hospital, Halton, Gp. Capt. George Hodgson, O.B.E., R.A.F. (retd.).

Slatter.—On Apr. 14, R.A.F. Hospital, Uxbridge, Air Marshal Sir Leonard Slatter, K.B.E., C.B., D.S.C., D.F.C., R.A.F. (retd.).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HEAD OFFICES: Bowling Green Lane, London, E.C.1, England. Telephone: Terminus 3636. Telegrams: "Pressimus, London, Telex." Telex: 23839.

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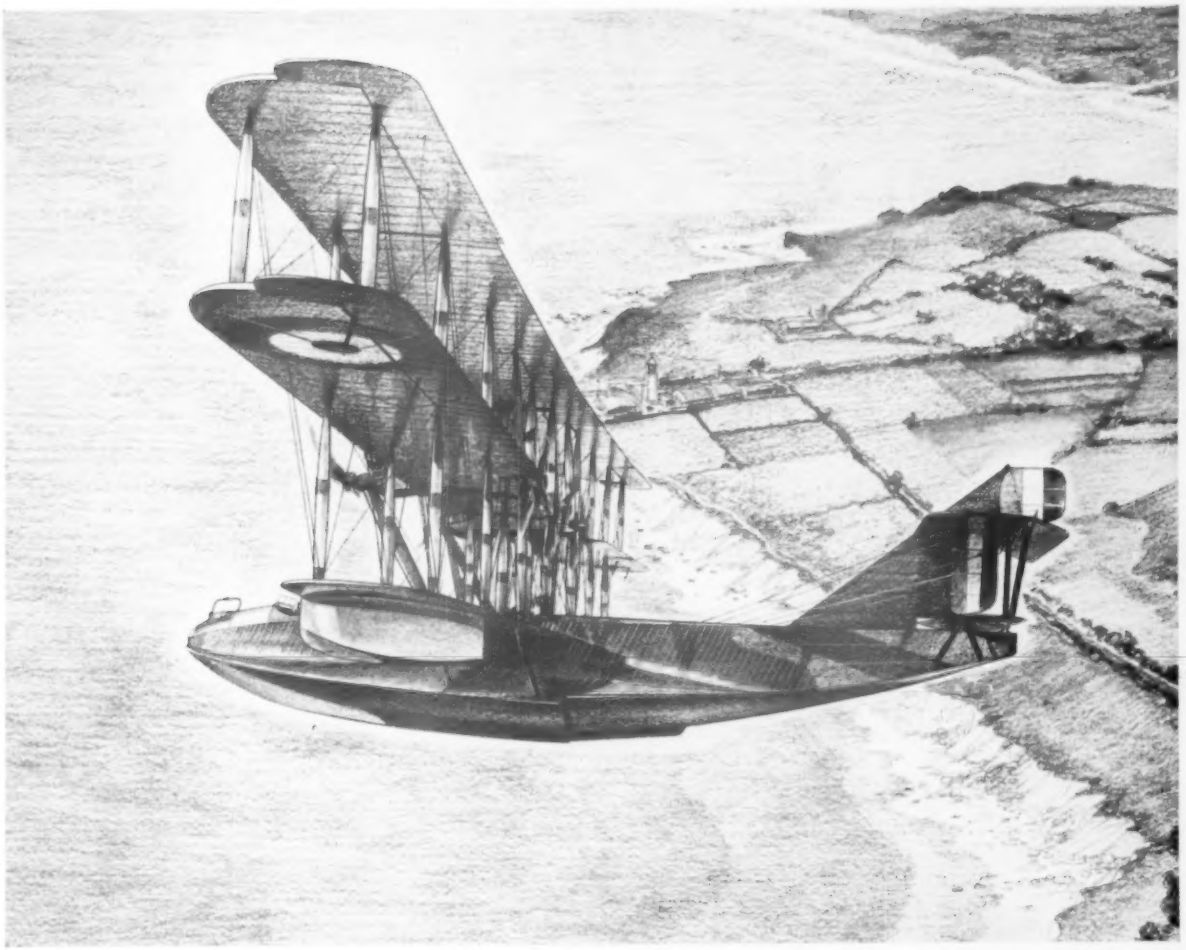

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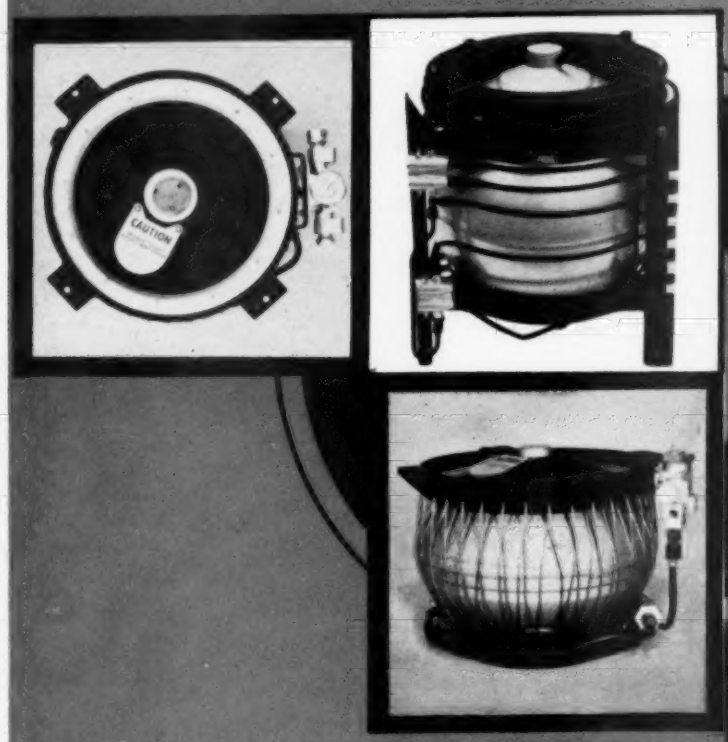

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